UC17 AND UC18
INTELLIGENT HOST ADAPTER
TECHNICAL MANUAL
(MSCP/TMSCP COMPATIBLE)

EMULEX

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Section 1
GENERAL DESCRIPTION

1.1 Introduction

This manual is designed to help you install and use your UC17 or UC18 Intelligent Host Adapter. It assumes that you have some knowledge of hardware configuration, UNIBUS bus architecture and terminology, and interpretations of error messages and device register contents.

The contents of the ten sections and four appendices are described as follows:

- **Section 1 (General Description)** contains an overview of the UC17/18 Intelligent Host Adapter.
- **Section 2 (Controller Specifications)** contains the specifications for the UC17/18 Host Adapter.
- **Section 3 (Installation and Configuration Planning)** discusses possible configurations, and some considerations for planning the configuration.
- **Section 4 (Installation)** contains the information needed to set up and physically install the controller, including switch settings and cabling.
- **Section 5 (NOVRAM Setup and Subsystem Testing)** describes the firmware-resident diagnostics and contains instructions for loading drive configuration parameters into the NOVRAM.
- **Section 6 (Troubleshooting)** describes fault isolation procedures that can be used to pinpoint trouble spots.
- **Section 7 (MSCP/TMSCP Compatibility and Programming)** describes the UC17/18's registers and presents an overview of the Mass Storage Control Protocol (MSCP).
- **Section 8 (Functional Description)** describes the controller architecture.
- **Section 9 (Interfaces)** describes the controller, UNIBUS bus and SCSI interfaces.
- **Section 10 (SCSI Protocol Description)** describes the protocol used on the SCSI bus.

- **Appendix A (Autoconfigure, CSR and Vector Addresses)** describes the DEC algorithm for the assignment of CSR addresses and vector addresses.
- **Appendix B (PROM Removal and Replacement)** contains instructions to remove and replace the firmware so that the user can upgrade the UC17/18 Host Adapter in the field.
- **Appendix C (Drive Parameters)** provides NOVRAM parameter-setting information for various optical and magnetic disk drives and subsystems.
- **Appendix D (Termination Power)** outlines the different methods for providing termination power.

1.2 Subsystem Overview

The UC17 Host Adapter connects high-capacity SCSI-compatible magnetic disk, optical disk, or magnetic tape subsystems to the UNIBUS in computers manufactured by Digital Equipment Corporation (DEC). Via switch selection, the UC17 implements either DEC's Mass Storage Control Protocol (MSCP) for disk subsystems or Tape Mass Storage Control Protocol (TMSCP) for tape subsystems to provide a software-transparent interface for the host DEC computer. The Small Computer System Interface (SCSI) peripheral interface provides traditional Emulex flexibility in peripheral selection.

The UC18 Host Adapter combines the capabilities of two UC17s on a single printed circuit board assembly. This allows the user to separate slow and fast SCSI peripherals, attaching slower tape devices or optical drives to one SCSI bus, while high-speed magnetic drives use the other SCSI bus.

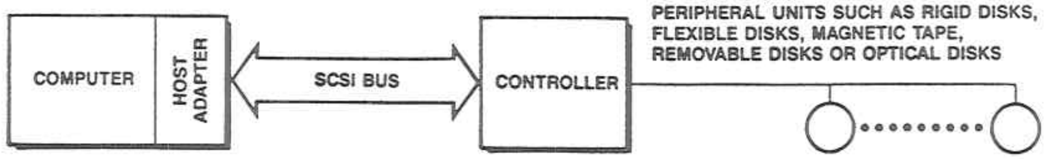
1.2.1 Mass Storage Control Protocol (MSCP)

MSCP is a software interface designed to lower the host computer's mass storage overhead by offloading much of the work associated with file management into an intelligent mass storage subsystem. In concert with SCSI-compatible peripherals, the UC17 provides just such a subsystem. The UC17 relieves the host CPU of many file maintenance tasks. The UC17 Host Adapter performs these MSCP functions: error checking and correction, bad block replacement, seek optimization, command prioritizing and ordering, and data mapping.

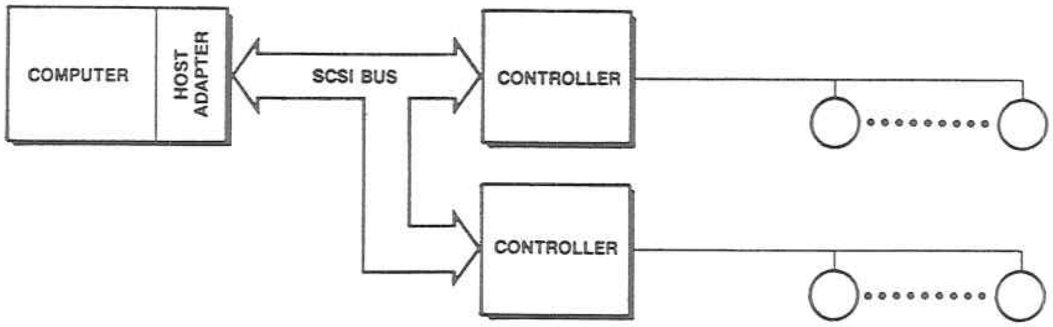
1.2.2 Small Computer System Interface (SCSI)

The Small Computer System Interface, which is used as the UC17 Host Adapter's peripheral interface, complements the MSCP protocol well. SCSI architecture is designed to allow up to eight host adapters and intelligent peripheral controllers to be connected together on an eight-bit data bus (the SCSI bus; see Figure 1-1). Host adapters, such as the UC17, connect computers to the SCSI bus. Intelligent peripheral controllers support mass-storage peripherals such as mini-Winchester disk drives or 8mm tape drives. The devices communicate over the SCSI bus using a device-independent protocol that largely masks the data structure of the peripheral. Thus, SCSI architecture allows the host computer to become device independent within certain classes of devices.

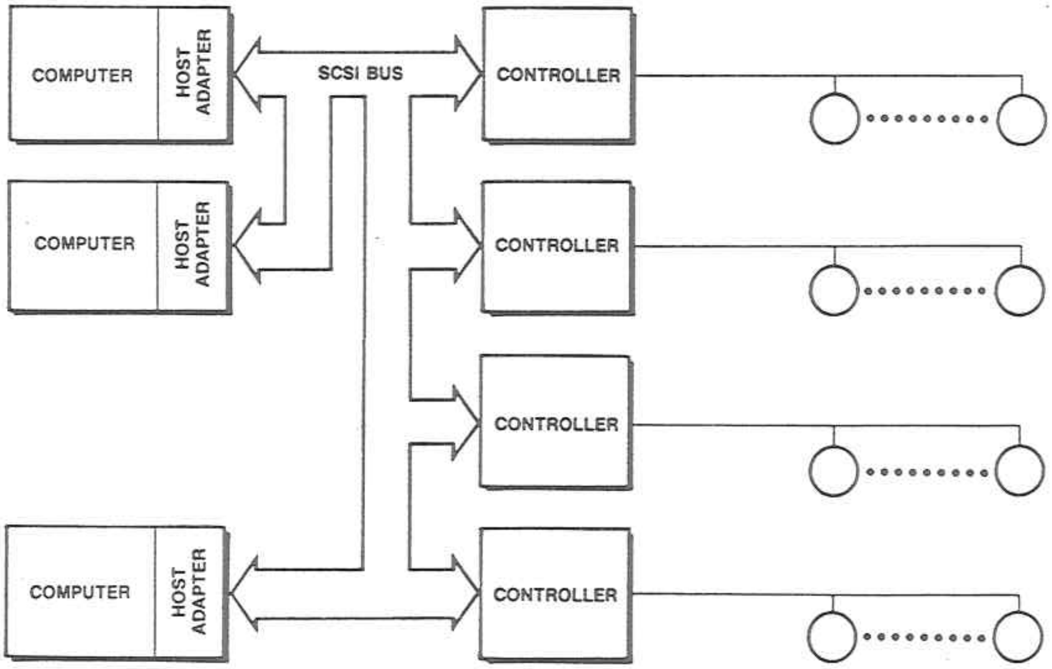
SCSI also provides for a large volume of data storage that can be configured in many ways. The bus is fast enough to support modern Winchester-technology disks, and the interface allows seeks and other types of positioning and data commands to be overlapped if there is more than one peripheral controller on the bus.


COMPUTER
HOST ADAPTER
SCSI BUS
CONTROLLER
PERIPHERAL UNITS SUCH AS RIGID DISKS, FLEXIBLE DISKS, MAGNETIC TAPE, REMOVABLE DISKS OR OPTICAL DISKS

SINGLE INITIATOR, SINGLE TARGET



SINGLE INITIATOR, MULTI TARGET



MULTI INITIATOR, MULTI TARGET

UC17/18-2062

Figure 1-1. SCSI Bus Overview

1.3 Physical Organization Overview

The UC17 or UC18 Intelligent Host Adapter is a quad-wide printed circuit board that contains either one (UC17) or two (UC18) microprocessor-based SCSI host adapters. The board connects directly to the host computer's UNIBUS.

In MSCP mode, each UC17 or UC18 SCSI port can support up to seven SCSI peripheral controllers. Each peripheral controller can have from one to eight devices attached to it. Regardless of the combination scheme, eight (8) is the maximum number of logical units that can be attached to a single UC17 or UC18 SCSI Port. The SCSI devices can be a mixture of magnetic disk or optical disk devices. Special software might be required when mixing optical and magnetic devices on the same UC17 or UC18.

In TMSCP mode, each UC17 or UC18 SCSI port can support up to seven tape devices with a SCSI interface.

Aggregate data storage capacities are limited only by the capacities of the peripherals.

Figure 1-2 shows two possible SCSI configurations for the UC17; Figure 1-3 shows a possible configuration for the UC18. The configuration in Figure 1-3 is a single CPU, multi-initiator, multi-target configuration. Figure 1-4 shows a dual CPU scheme which offers multiple access to a shared set of peripherals. Special software is required to support this application.

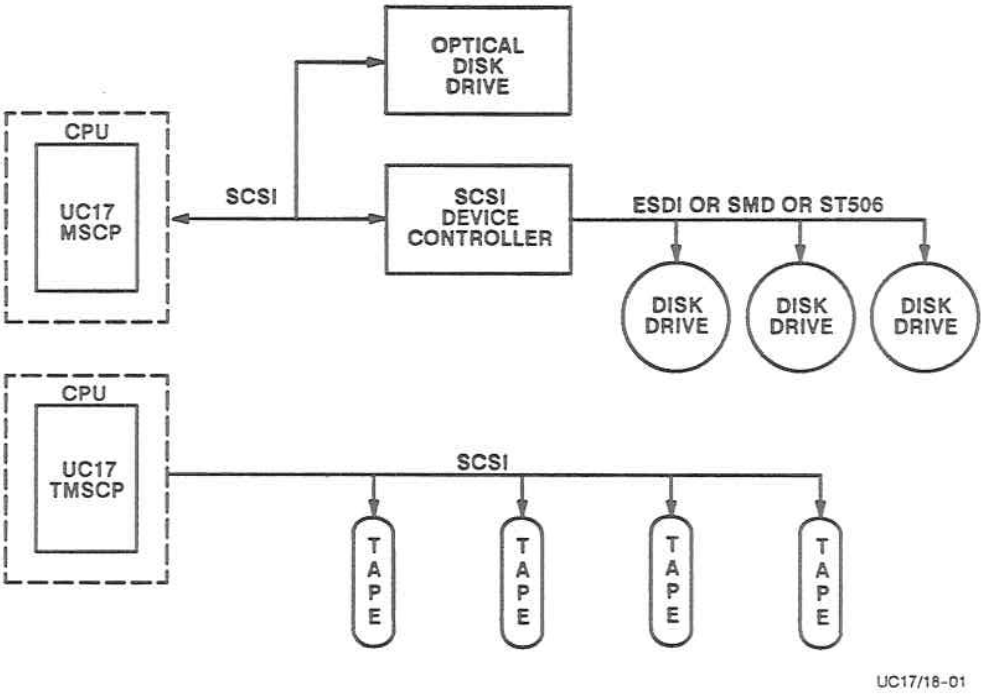


Figure 1-2. Typical UC17 Subsystem Configurations

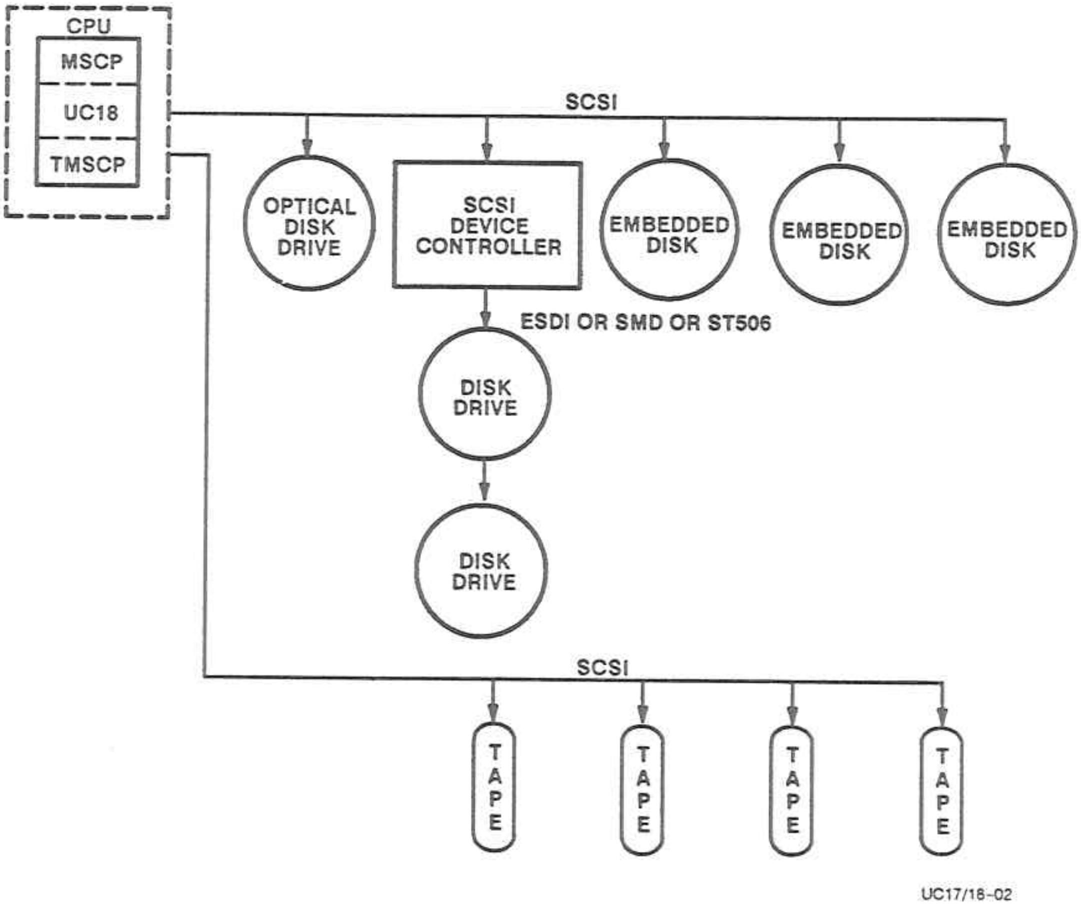


Figure 1-3. Typical UC18 Subsystem Configuration

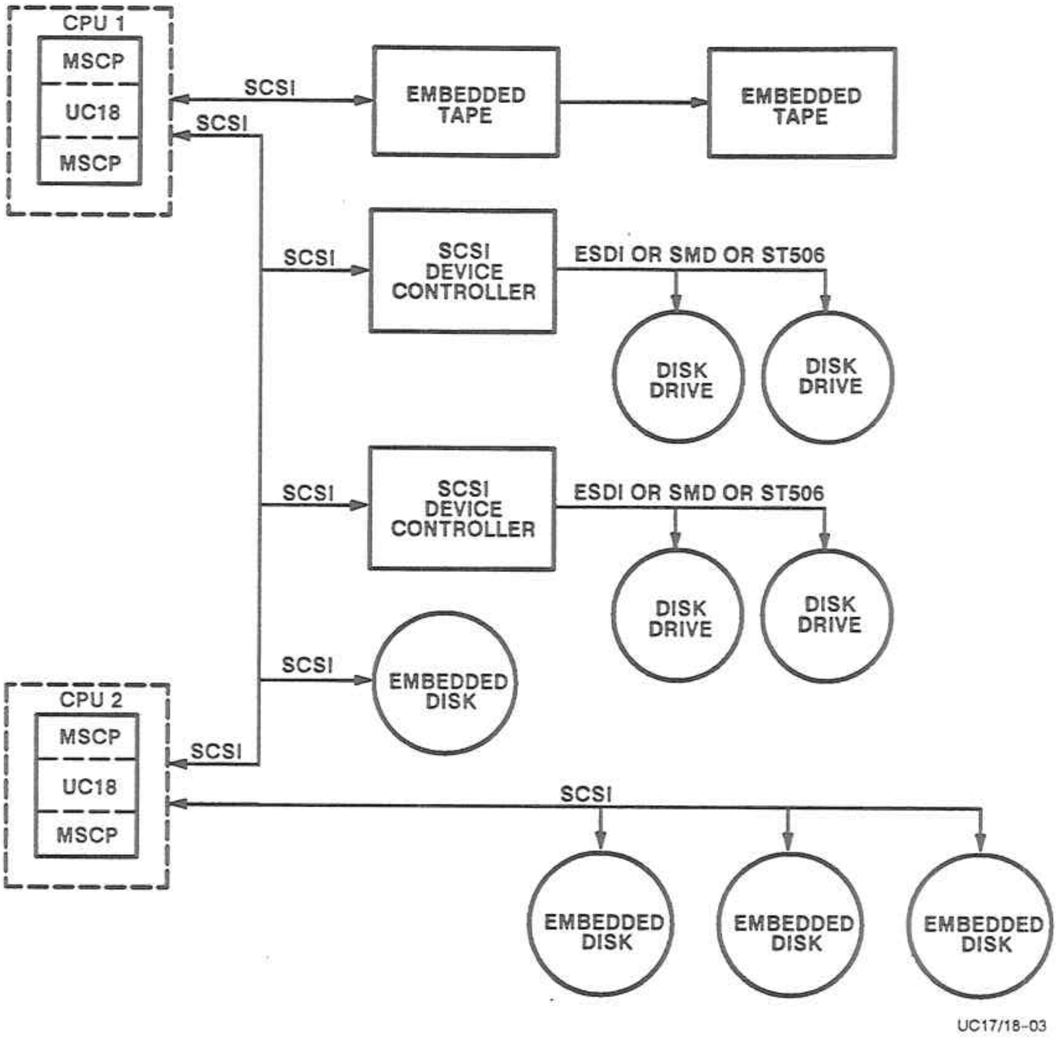


Figure 1-4. Dual CPU UC18 Subsystem Configuration

1.4 Host Adapter Models and Options

The intelligent host adapter, with appropriate peripherals, provides a DEC MSCP-compatible or TMSCP-compatible mass storage subsystem. The host adapter is available in two basic models: the UC17 and the UC18. The UC17 has a single SCSI port; the UC18 is a dual SCSI port version. The UC17 and UC18 are designed to be installed in any quad-wide Small Peripheral Controller UNIBUS slot. Each intelligent host adapter board is identified by a top level assembly tag that is glued to the 8031 microprocessor chip on the printed circuit board assembly. Tables 1-1 and 1-2 give the top level assembly number for each model of host adapters, along with the part numbers of the items that are delivered with them.

Table 1-1. UC17 Basic Contents

Itm	Qty	Description	Part Number
1	1	Host Adapter	UC1710201-02
2	1	Manual	UC1751001-00

Table 1-2. UC18 Basic Contents

Itm	Qty	Description	Part Number
1	1	Host Adapter	UC1810201-02
2	1	Manual	UC1751001-00

1.4.1 Subsystem Options

Table 1-3 lists the options that can be ordered to tailor your UC17 or UC18 to your particular application. Options are specified as separate line items on a sales order.

Table 1-3. UC17 and UC18 Options

Model No.	Part No.	Qty.	Description
CKUC17-H[1]	UC0710203-00	2	UC07 Transition Panels
	QT1411201-11	1	50-pin, high-density, 8-foot, shielded cable
	MU0111201-02	2	50-pin, 6-foot, flat cable
CKUC18-H[1]	UC0710203-00	2	UC07 Transition Panels
	QT1411201-11	2	50-pin, high-density, 8-foot, shielded cables
	MU0111201-02	4	50-pin, 6-foot flat cables
CKUC17-A[2]	PU0111216-03	1	50-pin, 6-foot flat ribbon cable with transition panel
	PU0111203-02	1	50-pin, 10-foot round shielded cable
CKUC18-A[2]	PU0111216-03	1	50-pin, 6-foot flat cable with transition panel
	PU0111203-02	2	50-pin, 10-foot round cable
	PU0111219-03	1	50-pin, 6-foot flat cable
	5200862	1	Cable connection ground plane
N/A	MU0111201-XX		Flat ribbon cables are available in various lengths for devices mounted in the same cabinet as the host adapter.

[1] Each transition panel requires a mounting frame. If a mounting frame is not available in your system, the CU22/Filler mounting kit is available from Emulex.

[2] Each transition panel requires a mounting frame. If a mounting frame is not available in your system, the DP22-00 mounting kit is available from Emulex.

1.5 Features

The following features enhance the usefulness of the UC17/18 Host Adapter.

1.5.1 Microprocessor Design

The UC17/18 design incorporates an eight-bit, high-performance CMOS microprocessor to perform all controller functions. The microprocessor approach provides a reduced component count, high reliability, easy maintainability, and the microprogramming flexibility that allows MSCP to be implemented without expensive, dedicated hardware.

1.5.2 Improved Throughput

By using our custom designed buffer controller chip and host adapter controller chip, the UC17/18 can perform DMA transfers on the host UNIBUS bus in excess of 2M bytes per second with a peak rate of 950 nanoseconds per word.

1.5.3 Firmware-resident Diagnostics

The UC17/18 host adapter firmware incorporates a self-contained set of media preparation and diagnostic utilities.

These utilities allow the user to communicate directly with the UC17/18 via a firmware-resident terminal driver that is compatible with either CRT or hardcopy devices connected to a UNIBUS or VAX console port. These firmware-resident diagnostics (F.R.D.) provide several important configuration and media preparation functions, including the ability to:

- Configure the host adapter NOVRAM
- Format magnetic disk drives
- Test the media surface of disk drives and replace defective blocks
- Perform reliability testing of the attached disk or tape subsystem
- Initialize the RCT area on optical media
- Provide read/write test capability on a special diagnostic area of the optical media

1.5.4 Custom Configuration Capability

An onboard NOVRAM can be programmed to support as many as seven SCSI-compatible controllers with peripherals of varying storage capacities. The user can specify many different drive configurations. Using the firmware-resident utilities, you can control drive parameters such as the number of disk sectors per track.

1.5.5 Self-test

The UC17/18 incorporates an internal self-test routine which exercises all parts of the microprocessor, the onboard memory, the buffer controller, the Host Adapter Controller (HAC), and the ESP chip. Although this is not a complete test of all circuitry, successful execution indicates a very high probability that the host adapter is operational. If the UC17/18 fails the self-test, it leaves three light-emitting diodes (LEDs) ON and sets an error bit in the Status and Address (SA) register (base address plus two).

1.5.6 Error Control and Block Replacement

The UC17/18 offers a choice of three different methods of error control which are user-selectable via NOVRAM. Each of these modes has unique advantages depending on the application.

1.5.7 Manual Bad Block Replacement

For magnetic disk devices, the firmware-resident diagnostics allow the user to manually enter bad blocks that are not replaceable with normal methods.

1.5.8 Command Queuing

The UC17/18 has a buffer that can store up to fifteen MSCP commands. The UC17/18 has the ability to sort these stored commands to provide optimal access to the attached disk drives. The ability to store and sort commands makes the UC17/18 particularly efficient in heavily loaded mulit-user systems.

1.5.9 Disconnect/Reconnect

The UC17/18 fully supports standard SCSI arbitration, including disconnect/reconnect. Using this feature, drives that are performing time-consuming tasks (e.g., seeks) release the SCSI bus temporarily and reconnect when the seek is complete. Support of this feature permits the UC17/18 to initiate commands simultaneously on multiple controllers; thus, several operations can be performed at once. The disconnect/reconnect option ensures efficient use of the SCSI bus and provides maximum overall subsystem throughput.

1.5.10 Adaptive DMA

During each DMA data transfer burst, the UC17/18 monitors the UNIBUS bus for other pending DMA requests and suspends its own DMA activity to permit other DMA transfers to occur. The host processor programs the DMA burst length during the MSCP or TMSCP initialization sequence, or the UC17/18 defaults to 16 words per burst. In addition, the UC17/18 allows the user to select the delay between data bursts via NOVRAM. Because of these adaptive DMA techniques, the UC17/18 ensures that CPU functions, including interrupt servicing, are not locked out for excessive periods of time by high-speed disk or tape transfers.

1.5.11 Multi-CPU Support

The UC17/18 offers two kinds of multi-CPU support: MSCP emulation and TMSCP emulation.

1.5.11.1 MSCP Emulation

The use of dynamic multi-initiator configurations in multiple CPUs has been added. This feature is required in multi-CPU configurations where asynchronous and unsolicited SCSI resets from one CPU must not be allowed to interfere with ongoing operations performed by other CPUs on the same SCSI bus. If this feature is used, all devices on the SCSI bus must support disconnects. Note that the current SCSI specification does not clearly define conditions that can occur if some SCSI devices on the same SCSI bus are powered OFF. Therefore, Emulex requires that all devices sharing a common SCSI bus be powered ON for proper operation.

Note that Write Once Read Many (WORM) optical drives are not supported in this configuration unless used for read-only purposes. Ensure that proper SCSI termination is observed, as well as maximum SCSI cable length. (See Table 2-1 for cable length details.)

1.5.11.2 TMSCP Emulations

The UC17/18 supports the use of multi-CPU configurations with the TMSCP emulation. However, because some SCSI tape devices could go into self-test modes which will run for up to 1.5 minutes, dynamic sharing of tape devices is not allowed. Emulex recommends each tape device be logically mounted to only one CPU at a time.

1.5.12 Fast File Search (Tape Emulation Only)

UC18 firmware supports the use of high speed file search operations available on EXABYTE tape drives. Certain limitations in the way high speed searches operate on the EXABYTE drive might not be compatible with all operations performed by various DEC operating systems; therefore, this feature can be disabled via a switch located on the UC17/18. Refer to Table 4-1 for switch settings.

1.5.13 User Selectable SCSI Autoconfigure

This feature allows the user to ask the UC17/18 to load its NOVRAM device information by using the INQUIRY, MODE SELECT, MODE SENSE, or READ CAPACITY commands to locate and identify all disk devices present on the SCSI bus. The Autoconfigure process also loads each device's physical geometry information into the NOVRAM for use as default values unless modified by the user.

This feature autoconfigures all available SCSI devices and all attached logical units until a maximum of eight drives are found. Once a device is identified, it is listed on the console with the vendor identification, the product identification, and the revision level (if the device is CSS compatible). Once completed, the default values are displayed if you wish to edit any entry. Only disk devices allow for Autoconfigure.

1.5.14 Multiple Tape Drive Support

The UC17/18 supports up to seven SCSI tape devices by appearing to the system as multiple drives attached to a single TMSCP tape coupler. Each device can be accessed individually.

Multi-drive configurations are very useful in applications that require automated unattended backups. With seven 8mm drivers attached to a single UC17 port, over 14 gigabytes of unattended backup capability are provided. In addition to the above convenience, the UC17 supports any mix of SCSI tape devices, including:

- 4mm DAT
- 8mm Helical Scan
- 1/2″ cartridge
- 1/2″ reel-to-reel
- Full 3480 compatibility

1.6 Compatibility

In designing the UC17/18, Emulex has made every effort to maintain compatibility with the SCSI Interface. However, due to the flexibility of the SCSI Interface Specification itself, and the large number of vendors producing "SCSI-compatible" disk and tape controllers, it is virtually impossible to guarantee that any particular SCSI disk or tape controller will function correctly when attached to the UC17/18. In addition, some of the restrictions imposed by the requirements of MSCP compatibility might prevent some devices which rely heavily on "vendor unique" command modifiers from being supported. The following section summarizes the various compatibility issues mentioned in the manual and also lists a number of vendor-specific devices that have been tested and found to work with the UC17/18.

1.6.1 Protocol Compatibility

The UC17/18 is compatible with the SCSI Interface Specification as defined by ANSI X3T9.2/82-2 Rev 17B for Direct Access, WORM, and Sequential Access devices. In addition, the industry standard Common Command Set is fully supported. The following documents were used for reference during the development of the SCSI interface on the UC17/18:

- ANSI specification X3T9.2/82-2 Rev 17B
- Imprimis SCSI Interface Specification 64721700 Rev B
- Emulex SCSI Disk Controller Programming Reference Manual (P/N MD2352501)
- Exabyte Corp. Interface Users Manual MKT-016-00
- Optimem Optical Disk Drive Interface Manual (P/N G09-083890-001)
- Maxtor Corp. XT-8000S Product Specification and OEM Manual (1015586 Rev A)

1.6.1.1 MSCP Compatibility

In the MSCP mode, when using magnetic disk drives, the UC17/18 is compatible with the standard DEC DU device driver used in all DEC operating systems. When using optical disk drives in MSCP mode, the UC17/18 is compatible with either the Emulex OD/OT Driver for VMS-based systems, or the optical software produced by Perceptics Corp.

In order to support the full host-initiated block replacement scheme provided by MSCP, the SCSI magnetic disk driver controller must support both the SCSI READ LONG and SCSI WRITE LONG commands as defined by the industry standard Common Command Set (CCS). All Emulex SCSI disk controllers support this requirement. When using non-Emulex device controllers, refer to the technical documentation supplied with the device.

1.6.1.2 TMSCP Compatibility

In TMSCP mode, the UC17/18 is fully compatible with the standard DEC TMSCP device driver for TK50/70 operation. Each SCSI port designated for TMSCP appears as one controller with up to seven tape devices attached.

1.6.2 Device Compatibility

The following is a list of the SCSI devices that have been tested or reviewed and found to be compatible with the UC17/18. If your device does not appear on this list it does not mean that it will not work. However, Emulex cannot guarantee correct operation or performance. In these cases, Emulex support will be limited to helping you identify the cause of the incompatibility.

CAUTION

> With the exception of products manufactured by Emulex, no warranties, either expressed or implied, are made as to the reliability or performance of any devices listed in this document. In addition, Emulex is not responsible for the applicability of any of the devices listed to a particular system configuration or for their intended use.

Magnetic Disk Controllers:

- Emulex MD01
- Emulex MD21
- Emulex MD23
- Emulex MD25

Magnetic Disk Drives with Embedded SCSI Controllers:

- Imprimis Wren Series
- Imprimis 9720S Series
- Imprimis Sabre 850S
- Maxtor 4000 Series
- Maxtor 8000S Series
- Micropolis 137XS Series
- Priam 738
- Hewlett-Packard 97548S

Optical Disk Drives:

- LMSI LD1200 12-inch
- LMSI LD5105 5.25-inch
- Optimem 1000/Rev 2 SCSI Controller
- Optimem 2400
- Laserdrive Ltd. Model 840
- Sony Magneto Optical Drive
- Richo Magneto Optical Drive

Magnetic Tape Drives:

- Exabyte Corp. 8400 8mm Tape Drive
- Sony 4mm DAT Drive
- Gigatrend 4mm DAT Drive
- LMSI 3480

1.6.3 CPU Compatibility

The UC17/UC18 is compatible with the UNIBUS used on all DEC 75XX, 78XX, 86XX, 82XX, and PDP-11 computers.

1.6.4 Known Limitations

ULTRIX 11 and ULTRIX 32M share the same EXABYTE limitation: When either system is used with EXABYTE in TMSCP mode, the "r" key cannot be used with *TAR* (Tape Archive) to append files. This operation requires the drive to position between blocks and overwrite. The drive is not capable of this operation.

Note that the following support only one tape drive per TMSCP port:

- RSX11M
- RSX11M PLUS
- RSTS/E
- RT11

Your software might create a second limitation: Automated switching of tape drives at EOT as used in unattended backup is the responsibility of the operating system software. VMS supports the definition of multiple tape units as part of its backup utility; however, your software must support this feature. Consult your VMS backup utility documentation for details regarding available features and configuration.

Other operating systems might require special software or command files written by the user. Consult the appropriate documentation.

The current version of UC17/18 firmware does not support the SCSI Reserve and Release functions. It therefore cannot function as a dual-ported disk in applications that require the disk to be on-line to only one CPU at a time (to provide proper Lock Management Functions). Such applications include LAVC or other non-HSC-based cluster configurations.

In a case where multi-CPUs share a common set of multiple tape drives, Emulex recommends that each tape device be logically mounted by only one CPU at a time. It is possible for each CPU to simultaneously mount and access different tape drives on the same SCSI bus.

1.6.5 Multi-initiator

This configuration can be used in applications that require multiple CPU access to a shared set of peripherals among two or more CPUs. By programming the NOVRAM on each host adapter, the user can determine which of the attached drives can be accessed by any CPU. This configuration requires special care to prevent dynamic multi-access unless special software is used to perform Lock Management Functions.

Also, because the Intelligent Host Adapter passes UNIBUS resets directly through to the SCSI bus in the form of SCSI bus resets, some form of protection must be defined to prevent the host adapter on any one CPU from issuing SCSI resets while the SCSI bus is being accessed by another host adapter. This condition has been eliminated with UC17/18 firmware. However, in TMSCP mode SCSI resets are not filtered; exercise care to prevent power up or booting of other CPUs attached to the same tape SCSI port, both of which might cause resets during tape operations.

Section 2
CONTROLLER SPECIFICATIONS

2.1 Overview

This section contains the general, environmental, physical, and electrical specifications for the UC17/18 Host Adapter.

Subsection	Title
2.1	Overview
2.2	General Specifications
2.3	Environmental Specifications
2.4	Physical Specifications
2.5	Electrical Specifications

2.2 General Specifications

Table 2-1 contains general specifications for the UC17/18 Host Adapter.

Table 2-1. UC17/18 General Specifications

Parameter	**Description**	
FUNCTION	Providing mass data storage to Digital Equipment Corporation (DEC) computers that use the UNIBUS	
Logical CPU Interface	Switch-selectable emulation of DEC's Mass Storage Control Protocol (MSCP) or Tape Mass Storage Control Protocol (TMSCP)	
Diagnostics	Embedded diagnostics	
Operating System Compatibility (MSCP)	VMS	V4.0 and above
	RSTS/E	V8.0 and above
	RSX-11M	V4.1 and above
	RSX-11M PLUS	V2.1 and above
	RT-11	V5.1 and above
	Ultrix-11	V3.0 and above
	Ultrix-32m	V1.1 and above
Operating System Compatibility (TMSCP)	VMS	V4.0 and above
	RSTS/E	V9.6 and above
	RSX-11M PLUS	V3.0 and above
	RT-11	V5.4 and above
	Ultrix-11	V3.0 and above
	Ultrix-32m	V2.2 and above

(continued on next page)

Table 2-1. UC17/18 General Specifications (continued)

Parameter	**Description**	
CPU I/O Technique	Direct Memory Access (DMA), including adaptive techniques	
INTERFACE		
CPU Interface	UNIBUS	
Device Base Address (MSCP)	Standard	17772150_8
	Alternates	17772154_8 17760334_8 17760340_8 17760344_8 17760350_8 17760354_8 17760360_8 17760364_8 17760370_8 17760374_8 17760400_8 17760404_8 17760410_8 17760414_8 17760420_8
Device Base Address (TMSCP)	Standard	17774500_8
	Alternates	17760404_8 17760410_8 17760414_8 17760444_8 17760450_8 17760454_8 17760504_8 17760510_8 17760514_8 17760520_8 17760524_8 17760530_8 17760534_8 17760540_8 17760544_8
Vector Address	Programmable	
Priority Level	BR5	

(continued on next page)

Table 2-1. UC17/18 General Specifications (continued)

Parameter	Description
Peripheral Interface	Small Computer System Interface (SCSI)
Driver Option	Single ended
Maximum Length	20 ft. (6 m.)
SCSI Commands used with MSCP Implementation	00H Test Unit Ready 03H Request Sense 04H Format Unit 07H Reassign Block 08H Read 0AH Write 12H Inquiry 15H Mode Select 1AH Mode Sense 1BH Start/Stop Unit 25H Read Capacity 28H Read (extended) 2AH Write (extended) E8H Read Long** EAH Write Long**
Firmware Diagnostic Access Path	
PDP-11	Standard console terminal
VAX	Standard console terminal

*Formatting only
**Vendor-unique commands on Emulex disk drive controllers

2.3 Environmental Specifications

Table 2-2 contains the environmental specifications for the UC17/18 Host Adapter.

Table 2-2. UC17/18 Environmental Specifications

Parameter	Description
OPERATING TEMPERATURE	10°C (50°F) to 40°C (104°F), where maximum temperature is reduced 1.8°C per 1000 meters (1°F per 1000 feet) altitude
RELATIVE HUMIDITY	10% to 90% with a maximum wet bulb of 28°C (82°F) and a minimum dewpoint of 2°C (3.6°F)
COOLING	6 cubic feet per minute
HEAT DISSIPATION	UC17: 40 BTU per hour UC18: 80 BTU per hour

2.4 Physical Specifications

Table 2-3 contains the physical specifications for the UC17/18 Host Adapter.

Table 2-3. UC17/18 Physical Specifications

Parameter	Description
PACKAGING	Single, quad-wide, four-layer PCBA
Dimensions	10.436 by 8.70 inches 26.507 by 22.098 centimeters
Shipping Weight	3 pounds

2.5 Electrical Specifications

Table 2-4 lists and describes the electrical specifications for the UC17/18 Host Adapter.

Table 2-4. UC17/18 Electrical Specifications

Parameter	Description
POWER	UC17: +5 VDC ± 5%, 2.3 A max.* UC18: +5 VDC ± 5%, 4.5 A max.*
BUS LOADING	AC bus loads: 2.5 max. DC bus loads: 1 max.
SCSI BUS TERMINATION POWER	Jumper-selectable, 4.75 VDC to 5.25 VDC, diode-isolated and fused at 1 A

*Maximum current rating might be slightly higher if board is jumpered to supply terminator power.

3.1 Overview

This section is designed to help you determine the best possible subsystem configuration for your application. It outlines performance capabilities, design constraints, and other factors which must be taken into account when configuring your subsystem. It is not intended to help you generate, adjust, or configure your operating system to use a UC17- or UC18-based subsystem. For information on these subjects you should consult your operating system documentation.

The UC17 and UC18 are high speed, Intelligent Host Adapters that allow you to interface a wide variety of SCSI devices to the DEC UNIBUS. The use of the SCSI bus as the peripheral bus provides a high degree of configuration flexibility not normally available with device controllers using dedicated peripheral buses. The following subsections show some of the possible configurations and outline the performance issues and restrictions that apply to each:

Subsection	Title
3.1	Overview
3.2	UC17 and UC18 Versions
3.3	UC17 and UC18 Configurations
3.4	Performance Considerations

3.2 UC17 and UC18 Versions

The Intelligent Host Adapter is available in two basic versions, the UC17 and the UC18.

3.2.1 UC17

The UC17 is the most basic version of the Intelligent Host Adapter. It consists of a single UNIBUS to SCSI bus Host Adapter on one quad-wide circuit board. The UC17 appears to the operating system as a single MSCP or TMSCP emulation (depending on board setup) that resides at one of 16 switch selectable base addresses assigned to MSCP or TMSCP emulations. The UC17 performs either an MSCP or a TMSCP emulation, determined by an onboard switch setting. If desired, the SCSI bus of two or more UC17 Host Adapters can be connected to the same SCSI cable to form a single SCSI bus with shared peripherals. However, this type of connection is only usable if all Host Adapters are set to perform the same type of emulation (MSCP or TMSCP). In either mode, each SCSI Port can support a maximum of seven (7) SCSI target devices. Each MSCP SCSI target can support up to eight (8) LUNs; however, the maximum number of LUNs that can be attached to an MSCP SCSI Port is eight (8).

3.2.2 UC18

The UC18 consists of two completely independent Intelligent Host Adapters, each with its own UNIBUS and SCSI bus interface, on one quad-wide circuit board. The UC18 appears to the operating system as two independent MSCP or TMSCP emulations, each of which reside at one of 16 switch selectable base addresses assigned to MSCP and TMSCP emulations. Each of the host adapters is individually switch selectable for either MSCP or TMSCP emulation. Thus, one UC18 can appear to the operating system as either one MSCP and one TMSCP, two MSCP or two TMSCP emulations. If desired, the two SCSI buses on one UC18 Host Adapter can be connected to the same SCSI cable to form a single SCSI bus with shared peripherals. However, this type of connection is only usable if both UC18 sections that share the SCSI bus are set to perform the same type of emulation (MSCP or TMSCP). In either mode, each SCSI port can support a maximum of seven (7) SCSI target devices. Each MSCP SCSI target can support up to eight (8) LUNs; however, the maximum number of LUNs that can be attached to an MSCP SCSI port is eight (8).

3.3 UC17 and UC18 Configurations

NOTE

A SCSI device can be either an initiator or a target. An initiator is a SCSI device that requests an operation to be performed by another SCSI device. A target is a SCSI device that performs an operation requested by an initiator. On the SCSI bus, the UC17/18 always acts as an initiator.

The possible configurations for the Intelligent Host Adapter are as follows:

1. **Single initiator, single target, single host adapter.**

   This is the most basic use of the UC17 or UC18. The UC17 can function as either an MSCP or TMSCP controller. When performing an MSCP emulation, the attached target device can be either a magnetic disk device, an optical disk device, or a magneto-optical disk device.

2. **Single initiator, multi-target, single host adapter.**

   In this configuration, the UC17 initiator can be in MSCP or TMSCP mode. Special software might be required when using this configuration with a mixture of optical WORM and magnetic drives on the same MSCP emulation. In general, there are no restrictions to mixing 4mm, 8mm, or other SCSI tape devices on the same SCSI port. Tapes and disks must not be mixed on the SCSI Bus in this configuration because a host adapter would be required to perform MSCP and TMSCP simultaneously.

3. **Single initiator, single target, dual host adapter.**

   This configuration uses either two UC17s or a single UC18. It is most generally used with the UC18 when a single CPU needs both MSCP and TMSCP on a single quad-wide board slot.

   This configuration can also be used to allow mixing of both magnetic and optical disks on the same CPU, while allowing the user to operate the magnetic disk with the standard DEC DU Driver while a separate custom driver is used for the optical disks.

   Another possible use of this configuration is in a single CPU system with multiple drives, where the user wants to split the drives between two host adapters to balance the DMA load and provide better performance than is possible with multiple drives on one host adapter.

4. **Single initiator, multi-target, dual host adapter.**

   This is very similar to Configuration 3 above, except that if each initiator is performing TMSCP or MSCP emulation, then each initiator can support multiple targets on its SCSI bus.

5. **Multi-initiator, single or multi-target, dual host adapter, multi-CPU.**

   The current version of UC17/18 firmware does not support the SCSI Reserve and Release functions. It therefore cannot function as a dual-ported disk in applications that require the disk to be on-line to only one CPU at a time (to provide proper Lock Management Functions). Such applications include LAVC or other non-HSC-based cluster configurations.

   It is still possible for each CPU to simultaneously mount and access different tape drives on the same SCSI bus because multi-CPUs share a common set of multiple tape drives; however, Emulex recommends that each tape device be logically mounted by only one CPU at a time.

6. Other Complex Configurations.

Figure 3-1 illustrates a very complex multi-CPU, multi-host adapter configuration, which demonstrates the high degree of system configuration flexibility that the Intelligent Host Adapter provides. This configuration requires special lock management software to control multi-user dynamic access to the shared peripherals.

In this configuration, one of the magnetic disks shared by CPU "A" and CPU "B" is set up as a split logical drive. CPU "A" is set up to use the first half of this drive as the system disk, and to bootstrap from this disk. The second half of the drive is either mounted as Read Only or left unmounted by CPU "A". CPU "B" is set up to use the second half of the split drive as the system disk, and to bootstrap from this disk, with the first half of the disk mounted as Read Only or unmounted.

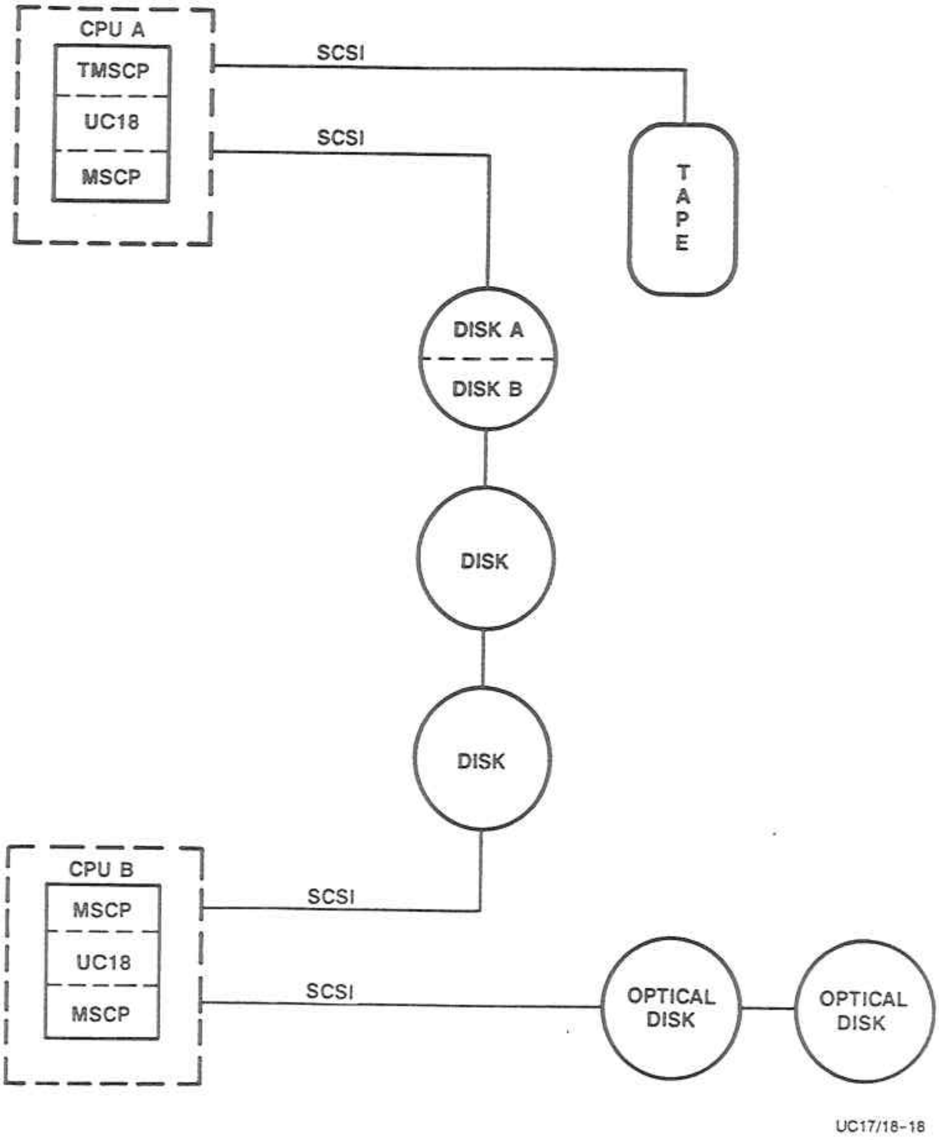


Figure 3-1. Complex UC18 Configuration

3.4 Performance Considerations

3.4.1 Disk Subsystems

The UC17 Host Adapter uses the Emulex ESP chip to provide an extremely high speed logical connector to the SCSI bus. In addition, the UC17 supports synchronous transfer disk devices that can support transfer rates up to 4.9 M bytes per second.

The main advantage offered by the UC17 is configuration flexibility. In many applications, this will far outweigh the slightly lower performance. In addition, SCSI's ability to interleave DMA operations in multi-drive, multi-tasking applications might provide better performance than a similarly configured ESDI subsystem.

3.4.2 Tape Subsystems

The UC17/18 can be used with a wide variety of SCSI-based tape drives. The main differences between drive types used will show in capacity and performance. The following sections list the effects of drive type.

3.4.2.1 8mm and 4mm Cartridge Tape Drives

The UC17 can be used with a wide variety of 8mm to 4mm DAT tape drives to emulate a DEC TK50/70 subsystem. The UC17 and Exabyte combination offers the user a highly reliable, extremely high capacity tape subsystem. However, this combination does perform differently than a SCSI-based 1/2 inch reel-to-reel tape subsystem. In general, the following differences should be expected:

- The transfer rate of the UC17/EXABYTE is lower than that available with a 50 IPS or faster GCR tape subsystem. However, backup times in multi-reel backup applications will be similar or lower for the UC17/Exabyte subsystem due to more efficient streaming and lack of operator intervention for tape changing.

- Any operations that utilize large amounts of tape positioning and directional changes will be considerably slower on the UC17/Exabyte tape subsystem. This means that logical operations such as mounting, initializing, etc., will appear to take longer than would similar operations on traditional tape subsystems. 4mm DAT will offer some improvement over 8mm, but will not be as fast as 1/2" cartridge or reel-to-reel drives.
- Emulex strongly recommends that the 8mm- and 4mm-based tape subsystems be used primarily with minimum tape positioning utilities such as VMS Backup, RSX-11M BRU, RSTS Backup or SAVRES, or RT11 BUP. Other utilities such as COPY, PIP, and FLX should be used only as absolutely necessary. While the UC17 is compatible with all these utilities, the combination of positioning commands, file mark generation, etc., associated with these utilities makes the UC17 tape subsystem very slow when compared to traditional tape subsystems.

3.4.2.2 1/2" Cartridge and Reel-to-Reel Drives

1/2" cartridge drives, such as the LSMI 3480, or 1/2" reel-to-reel drives, offer performance comparable to standard 1/2" Pertec Interface tape drives. This means that all normal utilities used with traditional Pertec tape subsystems can be used with no performance penalties.

Section 4
INSTALLATION

4.1 Overview

This section describes the installation of the UC17/18 Host Adapter. Including this overview, this section is divided into six main subsections:

Subsection	Title
4.1	Overview
4.2	Inspection
4.3	Host Adapter Setup
4.4	Installing the UC17/18
4.5	Physical Installation
4.6	Operation

The installation subsections **do not** contain every step necessary for bringing up the system. An Installation Checklist for each model outlines the process at the beginning of each installation subsection.

If you are unfamiliar with the subsystem installation procedure, Emulex recommends reading this Installation Section before beginning.

The UC17/18 is software transparent to DEC MSCP and TMSCP drivers used by VMS, ULTRIX, RSTS/E, RSX11M, RSX11M+, and RT11. Refer to DEC software documentation for sysgen, addressing, and other information.

4.1.1 Subsystem Configurations

This section is limited to switch setting data and physical installation instructions. No attempt is made to describe the many subsystem configurations that are possible.

When you are installing the subsystem, you should make a record of the subsystem configuration and environment. Figure 4-1 is a Configuration Record Sheet that lists the information required and shows where the data can be found. This information will be of help to an Emulex service representative should your subsystem require service.

UC17/18 CONFIGURATION REFERENCE SHEET

GENERAL INFORMATION

1. Host computer type ______________________________
2. Host computer operating system ______________________________
   Version ______________

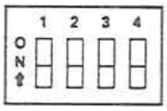
	Port 1 (UC17 and UC18)	Port 2 (UC18 only)
3. Subsystem Model	______________	______________
Controller(s)	______________	______________
	______________	______________
	______________	______________
Peripheral(s)	______________	______________
	______________	______________
	______________	______________

UC17/18 CONFIGURATION

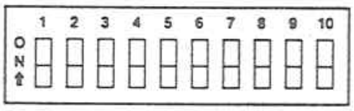
1. Warranty expiration date ______________________________
2. Top assembly number ______________________________
3. Serial number ______________________________

	Port 1 (UC17 and UC18)	Port 2 (UC18 only)
4. Firmware revision number	______________	______________
5. UNIBUS address	______________	______________
6. Interrupt vector address	______________	______________
7. Emulation (MSCP or TMSCP)	______________	______________

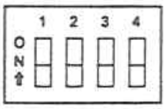
8. Switch settings (☐ = OFF ■ = ON)



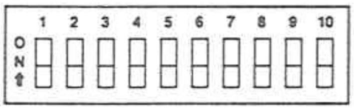
SW1



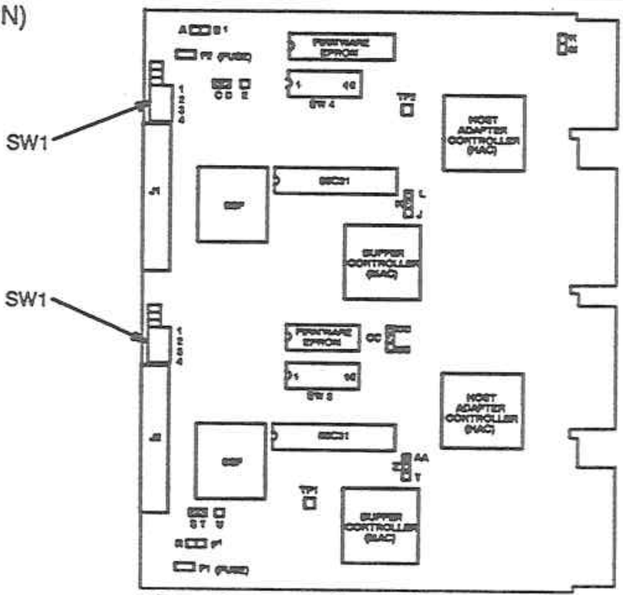
SW4



SW2



SW3



1 These jumpers configured IN. See Appendix D for termination power instructions.
NOTE: TP1 and TP2 are ground references.

U26 label identifies top assembly and serial numbers.
U29 label identifies Port 1 firmware revision. U22 label identifies Port 2 firmware revision.
Use Pencil

Figure 4-1. UC17/18 Configuration Reference Sheet

UC17/18-05

4.2 Inspection

Emulex products are shipped in special containers designed to provide full protection under normal transit conditions. Immediately upon receipt, the shipping container should be inspected for evidence of possible damage incurred in transit. Any obvious damage to the container, or indications of actual or probable equipment damage, should be reported to the carrier company in accordance with instructions on the form included in the container.

Unpack the UC17/18 subsystem and, using the shipping invoice, verify that all equipment is present. Verify also that model or part numbers (P/N), revision levels, and serial numbers agree with those on the shipping invoice. These verifications are important to confirm warranty. If evidence of physical damage or identity mismatch is found, notify an Emulex representative immediately. If the equipment must be returned to Emulex, it should be shipped in the original container. Refer to subsection 6.2 for details regarding the return of materials.

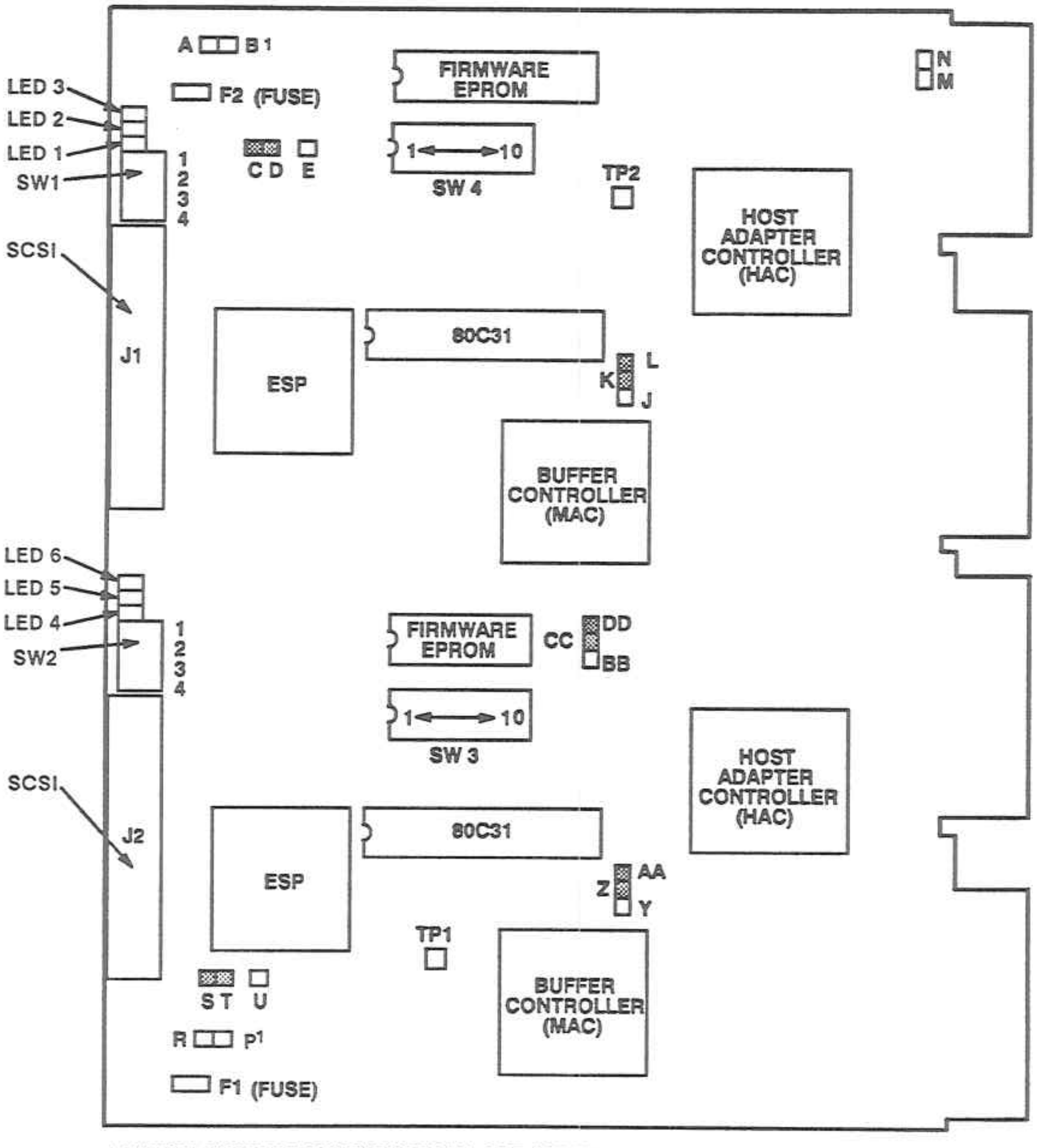
Visually inspect the UC17/18 Host Adapter after unpacking. Check for such items as bent or broken connector pins, damaged components, or any other evidence of physical damage.

Examine all socketed components carefully to ensure they are properly seated.

4.3 Host Adapter Setup

Before installing the UC17/18, you must set the bus address and emulation type. Since a UC18 includes two separate host adapters on a single board, you have to set the address and emulation for both adapters. Since it is necessary to differentiate between settings for the two adapters, we will call the adapter associated with the SCSI connector labeled J1, Port 1, and the adapter associated with connector J2, Port 2. If you have a UC17, you can ignore all references to Port 2.

Figure 4-2 shows the locations of the configuration switches, connectors, and jumpers on the UC17/18. The two figures also give the factory settings for all jumpers on the UC17/18. Jumpers that are installed at the factory are shown shaded in the two figures.



1 THESE JUMPERS CONFIGURED IN. SEE APPENDIX D FOR TERMINATION POWER INSTRUCTIONS.
NOTE: TP1 AND TP2 ARE GROUND REFERENCES.

Figure 4-2. UC17/18 Host Adapter Assembly

Table 4-1 defines the function and factory configuration of all switches on the UC17/18 adapter.

Table 4-1. UC17/18 Switch Definitions and Factory Configuration

Switch	OFF(0)	ON(1)	Fact	Function	Section
			Port 1 (J1)		
SW1-1	Run	Reset/Halt	OFF(0)	Run vs. Reset/Halt	6.4
SW1-2	Enable	Disable	OFF(0)	Fast File Search	4.3.6
SW1-3	-	-	OFF(0)	Reserved	
SW1-4	Normal	Loop	OFF(0)	Loop on Self Test Error	
SW4-1	-	-	OFF(0)	Host Adapter bus Address	4.3.2
SW4-2	-	-	OFF(0)	Host Adapter bus Address	4.3.2
SW4-3	-	-	OFF(0)	Host Adapter bus Address	4.3.2
SW4-4	-	-	OFF(0)	Host Adapter bus Address	4.3.2
SW4-5	TMSCP	MSCP	ON(1)	Emulation	4.3.1
SW4-6	Disable	Enable	OFF(0)	Autoboot (MSCP only)	4.3.4
SW4-7	-	-	OFF(0)	Reserved	
SW4-8	-	-	OFF(0)	Reserved	
SW4-9	-	-	OFF(0)	Reserved	
SW4-10	-	-	OFF(0)	Reserved	
			Port 2 (J2)		
SW2-1	Run	Reset/Halt	OFF(0)	Run vs. Reset/Halt	6.4
SW2-2	Enable	Disable	OFF(0)	Fast File Search	4.3.6
SW2-3	-	-	OFF(0)	Reserved	
SW2-4	Normal	Loop	OFF(0)	Loop on Self Test Error	
SW3-1	-	-	OFF(0)	Host Adapter bus Address	4.3.2
SW3-2	-	-	OFF(0)	Host Adapter bus Address	4.3.2
SW3-3	-	-	OFF(0)	Host Adapter bus Address	4.3.2
SW3-4	-	-	OFF(0)	Host Adapter bus Address	4.3.2
SW3-5	TMSCP	MSCP	ON(1)	Emulation	4.3.1
SW3-6	Disable	Enable	OFF(0)	Autoboot (MSCP only)	4.3.4
SW3-7	-	-	OFF(0)	Reserved	
SW3-8	-	-	OFF(0)	Reserved	
SW3-9	-	-	OFF(0)	Reserved	
SW3-10	-	-	OFF(0)	Reserved	

ON(1) = Closed
OFF(0) = Open

Reserved switches must be left OFF
Fact = Factory switch setting

NOTE

If you change a switch position on the UC17/18 or change configuration values in NOVRAM, you must also reset the UC17/18 so that the adapter's initialization sequence reads the codes established by the switch settings and/or NOVRAM. To reset the UC17/18, either toggle (ON then OFF) switch SW1-1 (SW2-1 for Port 2), or power-down and power-up the system.

4.3.1 Emulation

Each host adapter on the UC17/18 is capable of performing one of two emulations: MSCP to support disk devices, and TMSCP to support tape devices. Select the appropriate emulation for your application. See Table 4-2 for switch setting information.

Table 4-2. Emulation Selection

Port	Switch	OFF	ON	Function
1	SW4-5	TMSCP	MSCP	Emulation
2	SW3-5	TMSCP	MSCP	Emulation

4.3.2 Host Adapter Bus Address

Every UNIBUS I/O device has a block of several registers through which the system can command and monitor that device. The registers are addressed sequentially from a starting address assigned to that device, in this case an MSCP or TMSCP host adapter.

The starting address for the host adapter associated with Port 1 (J1) is selected using switches SW4-1 through SW4-4. When there is a second host adapter (Port 2) on the board (UC18), its address is selected using SW3-1 through SW3-4.

CAUTION

For UC18 boards, both Port 1 and Port 2 must not be set to the same host adapter bus address.

4.3.2.1 Disk (MSCP) Emulations

The address selected by the address switches varies depending on the emulation selected. Table 4-3 lists the addresses and switch settings for MSCP emulations.

The standard address for MSCP devices is 17772150, which is typically assigned to the first MSCP-type device on a system.

For more information on determining the required UNIBUS address, refer to the DEC operating system documentation.

Table 4-3. MSCP Emulation Bus Address Settings

Port 1 (J1)					Port 2 (J2)				
Bus Address (in octal)	--- SW4 --- 4	3	2	1	Bus Address (in octal)	--- SW3 --- 4	3	2	1
17772150	0	0	0	0	17772150	0	0	0	0
17772154	0	0	0	1	17772154	0	0	0	1
17760334	0	0	1	0	17760334	0	0	1	0
17760340	0	0	1	1	17760340	0	0	1	1
17760344	0	1	0	0	17760344	0	1	0	0
17760350	0	1	0	1	17760350	0	1	0	1
17760354	0	1	1	0	17760354	0	1	1	0
17760360	0	1	1	1	17760360	0	1	1	1
17760364	1	0	0	0	17760364	1	0	0	0
17760370	1	0	0	1	17760370	1	0	0	1
17760374	1	0	1	0	17760374	1	0	1	0
17760400	1	0	1	1	17760400	1	0	1	1
17760404	1	1	0	0	17760404	1	1	0	0
17760410	1	1	0	1	17760410	1	1	0	1
17760414	1	1	1	0	17760414	1	1	1	0
17760420	1	1	1	1	17760420	1	1	1	1

4.3.2.2 Tape (TMSCP) Emulations

The address selected by the address switches varies depending on the emulation selected. Table 4-4 lists the addresses and switch settings for TMSCP emulations.

The standard address for TMSCP devices is 17774500, which is typically assigned to the first TMSCP-type device on a system.

For more information on determining the required UNIBUS address, refer to the DEC operating system documentation.

Table 4-4. TMSCP Emulation Bus Address Settings

Port 1 (J1)					Port 2 (J2)				
Bus Address (in octal)	--- SW4 --- 4	3	2	1	Bus Address (in octal)	--- SW3 --- 4	3	2	1
17774500	0	0	0	0	17774500	0	0	0	0
17760404	0	0	0	1	17760404	0	0	0	1
17760410	0	0	1	0	17760410	0	0	1	0
17760414	0	0	1	1	17760414	0	0	1	1
17760444	0	1	0	0	17760444	0	1	0	0
17760450	0	1	0	1	17760450	0	1	0	1
17760454	0	1	1	0	17760454	0	1	1	0
17760504	0	1	1	1	17760504	0	1	1	1
17760510	1	0	0	0	17760510	1	0	0	0
17760514	1	0	0	1	17760514	1	0	0	1
17760520	1	0	1	0	17760520	1	0	1	0
17760524	1	0	1	1	17760524	1	0	1	1
17760530	1	1	0	0	17760530	1	1	0	0
17760534	1	1	0	1	17760534	1	1	0	1
17760540	1	1	1	0	17760540	1	1	1	0
17760544	1	1	1	1	17760544	1	1	1	1

4.3.3 Interrupt Vector Address

The interrupt vector address for the UC17/18 is programmed into the device by the operating system during the MSCP/TMSCP initialization sequence.

4.3.4 Autoboot (PDP-11 Only)

The UC17/18 has an autoboot feature which you can enable for Port 1 or Port 2 using switches as described in Table 4-5. See subsection 5.3.1.6 for a complete description of this option.

Table 4-5. Autoboot

Port	Switch	OFF	ON	Function
1	SW4-6	Disable	Enable	Autoboot
2	SW3-6	Disable	Enable	Autoboot

4.3.5 Interrupt Priority Level

The UC17/18 is factory configured for bus request (BR) level 5 (BR5). This is the preferred configuration for most DEC UNIBUS systems.

4.3.6 Fast File Search Switch

The UC17/18 is factory configured to enable Fast File Search mode on EXABYTE drives. In this mode, all software SPACE FILE MARK commands are sent unmodified directly to the tape drive. If the command is for the forward direction, the drive spaces forward at high speed the number of file marks specified in the command. However, because the EXABYTE cannot read while it is in high speed, the UC17/18 cannot keep track of the number of individual records that have been spaced over.

Although not usual, it is quite possible for an application program to request that the TMSCP tape device indicate its position on tape by maintaining a count of how many records from BOT it is on the tape. If your application requires this type of position tracking, it might be necessary for you to disable fast file search by turning SW1-2 to the ON position. When fast file search is disabled, the UC17/18 converts all SPACE FILE MARK commands to SPACE RECORD commands. This enables the UC17/18 to keep track of the exact number of records spaced over.

Emulex has verified that normal VMS/RSX utilities work correctly with fast file search enabled. Note that certain operating systems have demonstrated incompatibility with Fast File Search mode and might require that you disable the feature for proper operation.

4.4 Installing the UC17/18

This subsection describes the physical installation of the UC17/18 Host Adapter. You should have already completed steps 1 and 2 on the following Installation Checklist:

UC17/18 MULTI-CABINET INSTALLATION CHECKLIST

☐ 1. Inspect the UC17/18 Host Adapter. (Subsection 4.2)

☐ 2. Set up the switches and jumpers on the UC17/18 module. (Subsection 4.3)

☐ 3. Install the adapter in the CPU's backplane.

☐ 4. Install the UC17/18 Distribution Panel in the rack-mount cabinet (with the CPU) and connect to the UC17/18 PCBA.

☐ 5. Install a second UC17/18 Distribution Panel in the drive cabinet and connect the disk and/or tape drives to it.

☐ 6. Install high-density cables between the two cabinets.

☐ 7. Run the onboard embedded diagnostics. (This step includes formatting the disk drives.) See Section 5.

☐ 8. Bring up the system.

4.4.1 Maintaining FCC Class A Compliance

Emulex has tested the UC17/18 Intelligent Host Adapter with DEC computers that comply with FCC Class A limits for radiated and conducted interference. When properly installed, the UC17/18 does not cause compliant computers to exceed Class A limits.

The UC17/18 Host Adapter may be installed in a variety of configurations, with its associated SCSI subsystems in the same cabinet as the CPU and host adapter, and with the subsystem in a separate cabinet.

When the SCSI subsystem and UC17/18 are located in the same cabinet, they are connected with unshielded, 50-wire cables.

When the SCSI subsystem and the UC17/18 are located in separate cabinets, you must use shielded cables for the transition between the two cabinets. Also, the areas where the cable enters and leaves the CPU and subsystem cabinets must be constructed so as not to destroy the cabinet's RFI shielding capability. For such installations, it is the customer's sole responsibility to ensure that FCC Class A compliance is maintained by the system with the UC17/18 installed.

To limit radiated interference, DEC completely encloses the components of its computers that generate or could conduct radio-frequency interference (RFI) with a grounded metal shield (earth ground). During installation of the UC17/18, nothing must be done that would reduce this shield's effectiveness. That is, when the UC17/18 installation is complete, ensure that no gap in the shield will allow RFI to escape.

Conducted interference is generally prevented by installing a filter in the AC line between the computer and the AC outlet. Most power distribution panels that are of current manufacture contain suitable filters.

4.5 Physical Installation

4.5.1 System Preparation

Power down the system and switch OFF the main AC breaker at the rear of the cabinet (the AC power indicator will remain lighted). Slide the CPU out of the cabinet and remove the top cover. Remove the card cage shield to obtain access to the CPU and other modules.

4.5.2 Slot Selection

The UC17/18 can be inserted into any small peripheral controller (SPC) slot in either the DEC computer chassis or UNIBUS expansion chassis. The closer a module is to the CPU, the higher its DMA priority. The UC17/18 can be placed fairly far from the CPU because of its large buffer capacity.

Each CPU slot should contain a module. Card slots that would otherwise remain unoccupied should contain Bus Grant modules to provide interrupt acknowledge continuity.

NOTE

> The nonprocessor grant (NPG) jumper on the SPC card slot in which the controller is being installed **must be removed** to allow the controller to trap the NPG signal during DMA requests.

4.5.3 NPG Signal Jumper

The NPG jumper on the SPC card slot must be removed to allow the trapping of the NPG signal during DMA requests. Therefore, remove the NPG signal jumper between pins CA1 and CB1 on the backplane so that the NPG signal passes through the UC17/18 module.

Figure 4-3 shows a DD11-DK nine-slot backplane, with the enlargement depicting the layout of a typical socket as seen from the rear. (The enlargement is valid for each of the sockets on the backplane.) The figure of the backplane includes letters and numbers that are not actually on the backplane; they are included to help identify pin locations. Also, the numbers shown in the enlargement do not appear in the same location on the backplane; rather, they are located in about the center of the backplane.

Jumper locations are defined by a series of numbers and letters that show pin locations by socket, column, and row. To find the NPG signal jumper on the DD11-DK backplane, use the following procedure:

1. Find the appropriate socket (in this case C). The sockets of pins are lettered sequentially, beginning with A and proceeding to F.
2. Find the appropriate card slot. In Figure 4-3, the card slots are numbered 1 through 9 from right to left. The column of pins shown in the socket enlargement corresponds to card slot 7. Note that each card slot is four pins wide, as the enlargement shows.
3. Find the appropriate row of pins. As the enlargement shows, each number is labeled A through V, excluding G, I, O, and Q. Also, each row of pins is offset from the row on either side.
4. Find the appropriate number corresponding to the desired pin. As the enlargement shows, each number differentiates between two pins on the same row that correspond to the same card slot. A number 1 indicates the component side; a number 2 indicates the solder side.

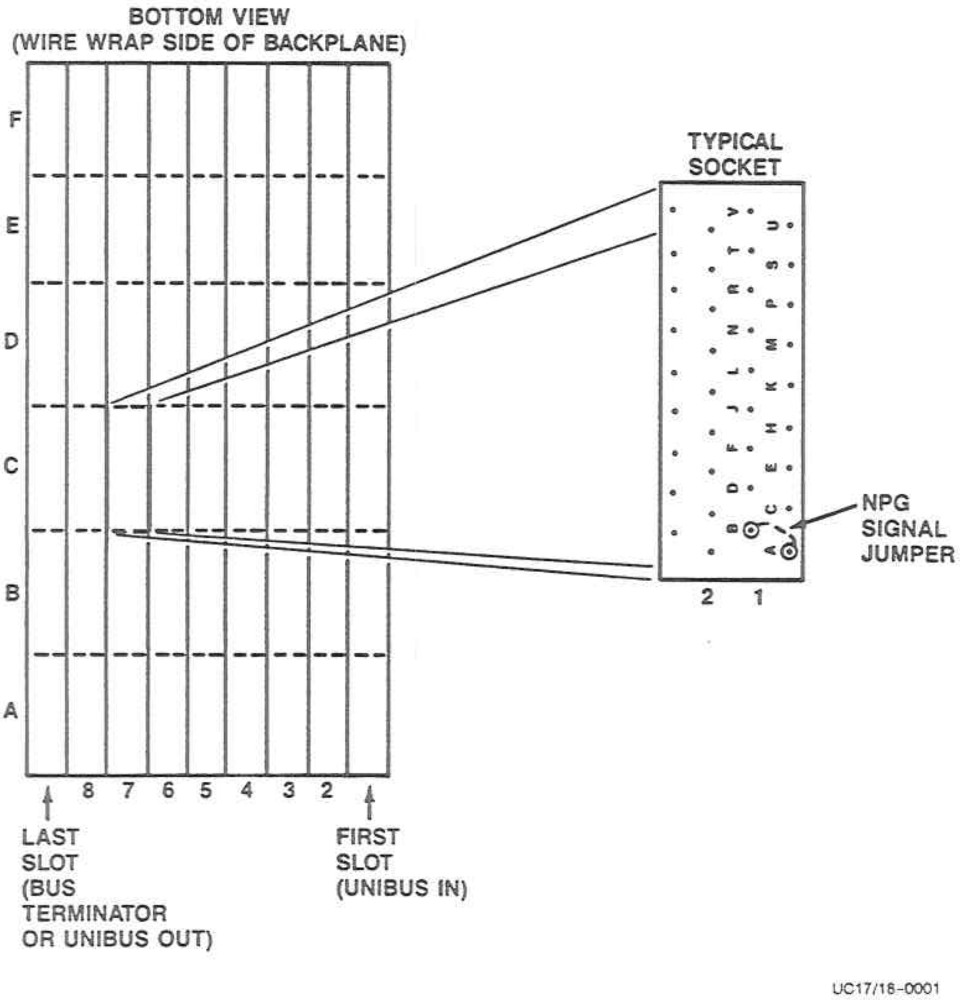


Figure 4-3. NPG Jumper Location

In summary: For the seventh card slot, pin CA1 refers to the fourth socket from the top of the backplane drawing (C), the top pin of the left-hand set (A1). CB1 is one pin to the right and slightly down. An arrow shows the wire between the two pins.

The wire-wrap jumper between CA1-CB1 is the bottom-most wrap on the pair. Once you have located the jumper, cut it. Slipping a small piece of insulation over the end of the pin facilitates later location.

If the UC17/18 is removed from the backplane, either reconnect the NPG jumper, or insert a dual-width grant continuity module into connectors C and D of the slot vacated by the module. The dual-width grant continuity module (DEC part number G7273) jumpers all grant signals (interrupt grants and nonprocessor grants). It can be ordered from Emulex using part number ZU1110812.

4.5.4 Mounting

The UC17/18 Disk Controller PWB should be plugged into the backplane with components oriented in the same direction as the CPU and other modules. Always insert and remove the boards with the computer power OFF to avoid possible damage to the circuitry. Be sure that the board is properly positioned in the throat of the guides before attempting to seat the board with the extractor handle.

4.5.4.1 SCSI Controller Preparation

The SCSI devices attached to the UC17/18 Host Adapter must be configured to work with the adapter. Generally, there are five variables that must be considered:

- The controller's SCSI bus address
- SCSI bus parity generation and checking
- SCSI bus disconnect/reconnect capability
- SCSI bus synchronous data transfer support
- Drive LUN and parameters

Every controller and host adapter on a given SCSI bus must have a unique address. (Remember that with the UC18, you have two separate SCSI ports and thus can have two separate buses.) The range of addresses available is from 0 to 7. Traditionally, the following addresses are assigned to the various devices on a SCSI bus:

Host Adapter	7
First Target Device	0
Second Target Device	1

These assignments are arbitrary, but the adoption of such a scheme ensures that no two devices are accidentally assigned the same number.

During your configuration of the UC17/18's NOVRAM (Section 5), you will be required to specify both the host adapter's SCSI address and the SCSI address(es) of the controllers to be supported. Select addresses for those controllers now and configure them accordingly. See the manufacturer's manual for instructions. Note that if you select the Autoconfigure feature, the SCSI address of all disk devices will be loaded by Autoconfigure in the NOVRAM.

The UC17/18 always generates parity during SCSI bus transfers. If parity checking is an optional feature of your SCSI controller, enable it now. If your controller cannot generate parity (presumably it will also not check parity, but that does not matter), you must disable the UC17/18's parity checking feature when you load the NOVRAM. See subsections 5.3.1.4 and 5.4.2.2.

The UC17/18 supports the SCSI disconnect/reconnect feature, which allows the target of a SCSI command to logically disconnect from the initiator while processing the command. This frees the SCSI bus for other operations and thus increases performance. If the controller you are using supports this feature, and you wish to use it, enable it now. You will also have to enable the UC17/18's support of this feature when you are loading its NOVRAM. See subsections 5.3.1.25 and 5.4.2.2.

The UC17/18 supports synchronous SCSI data transfers. If your SCSI device supports this feature, refer to the device's manual and take the steps necessary to enable it.

Every controller and host adapter on the SCSI bus must have a unique address; each drive on a controller must have a unique Logical Unit Number (LUN). If the drive has an embedded SCSI controller, its LUN is always 0. However, if your controller supports more than one drive (as with Emulex's MD25, which supports four), you will have to assign each drive a unique LUN starting with 0 (or 1 if that is the lowest number available for that drive type; the controller will still refer to it as LUN 0). Assign additional drive addresses sequentially (i.e., 0, 1, 2, ...).

Each drive will have some unique characteristics (i.e., SCSI Address, LUNs) that must be reported to the UC17/18 when you load NOVRAM. The UC17/18 will identify the drive by its controller's SCSI address and LUN. Note that using Autoconfigure loads the SCSI address of each SCSI device and the LUN of its attached disk drives in NOVRAM.

4.5.4.2 Subsystem Placement

Place and install the controller and drive assemblies according to the manufacturer's instructions. Position the subsystems in their final places before beginning the installation of the UC17/18. This positioning allows the I/O cable routing and length to be accurately judged.

4.5.5 Cabling (Separate Cabinets)

In an FCC compliant UC17/18 subsystem, the UC17/18 PCBA is installed in the cabinet and the SCSI subsystem is mounted in a separate cabinet. The UC17/18 interfaces with the SCSI device(s) it controls using one or two 50-conductor round shielded cables. The UC17/18-Distribution Panels, and two or four 50-conductor flat-ribbon cables. The number of cables required depends on whether a UC17 or UC18 is being installed. For the rest of this discussion, we will assume a two SCSI bus system is being installed. If not, ignore references to the Port 2 system (UC18 J2).

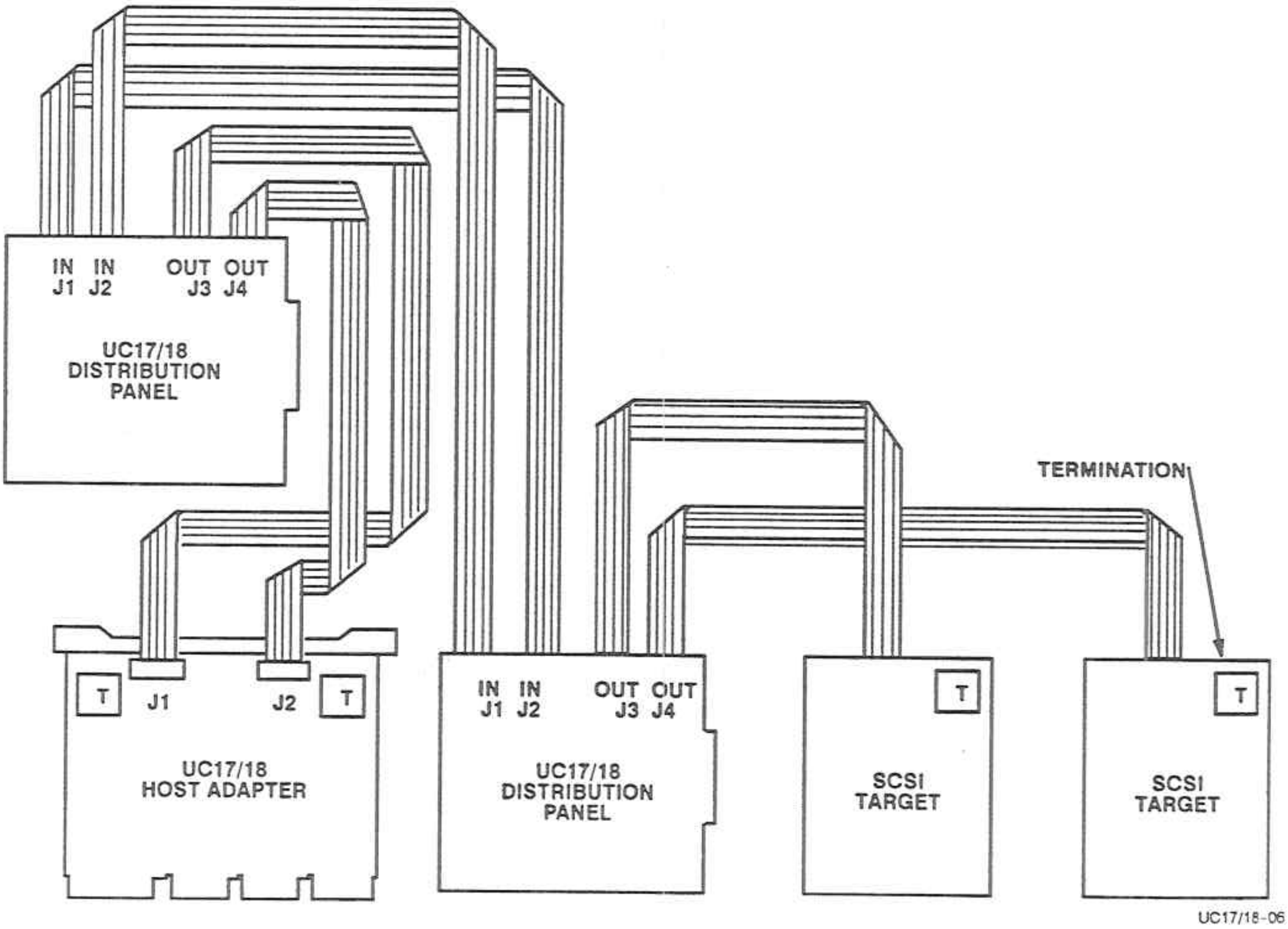


Figure 4-4. Basic Cabling

Because the UC17/18 PCBA and the SCSI subsystems are located in separate cabinets, the cables that run between the cabinets are shielded. The points of cabinet exit and entry must not cause the computer installation to exceed FCC limits for RFI. The UC17/18 distribution panel, rack-mount panel, and round-shielded cables designed for this purpose are available from Emulex (Table 1.3). The UC17/18 distribution panel (Figure 4-8) is designed to fit directly into a rack-mount panel which installs in any standard 19-inch RETMA rack. The rack-mount panel is shown in Figure 4-6.

Procedure:

1. Ensure the UC17/18 PCBA is installed in the backplane and that the system power is OFF.
2. Remove two of the four small panels from one side of the rack-mount panel (Figure 4-6). Install a UC17/18 distribution panel (Figure 4-5) in the resulting aperture and secure it with the four captive screws. Tighten the screws finger-tight. Make sure that no gaps are present around the UC17/18 distribution panel.

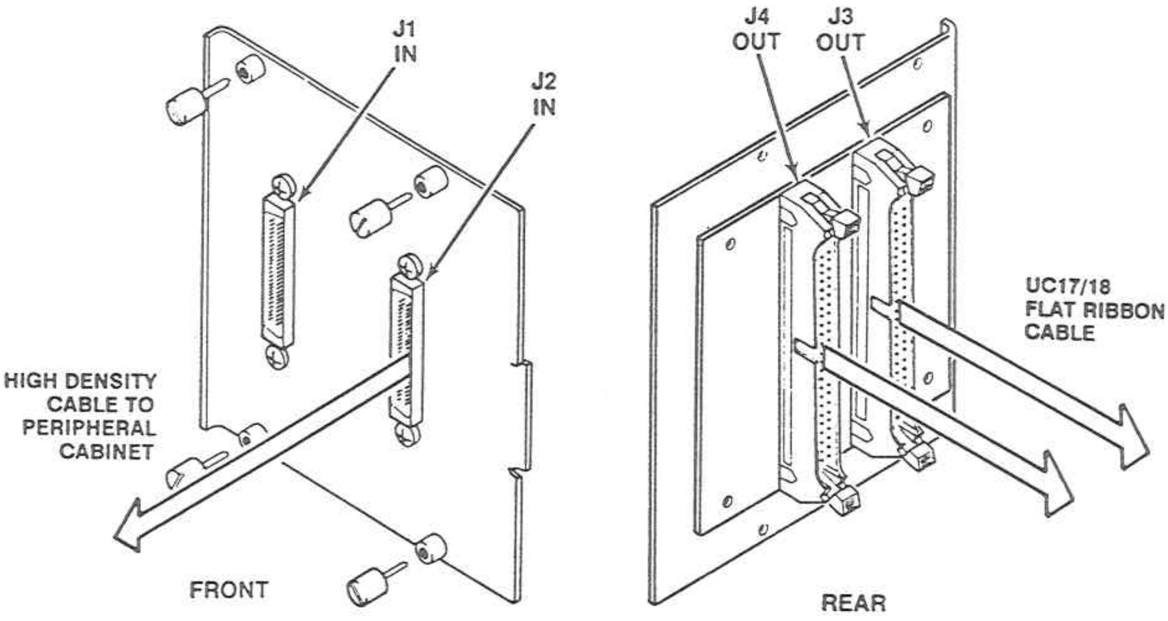

J1
IN
J2
IN
HIGH DENSITY CABLE TO PERIPHERAL CABINET
FRONT
J4
OUT
J3
OUT
UC17/18 FLAT RIBBON CABLE
REAR
UC17/18-11

Figure 4-5. UC17/18 Distribution Panel (CPU Cabinet)

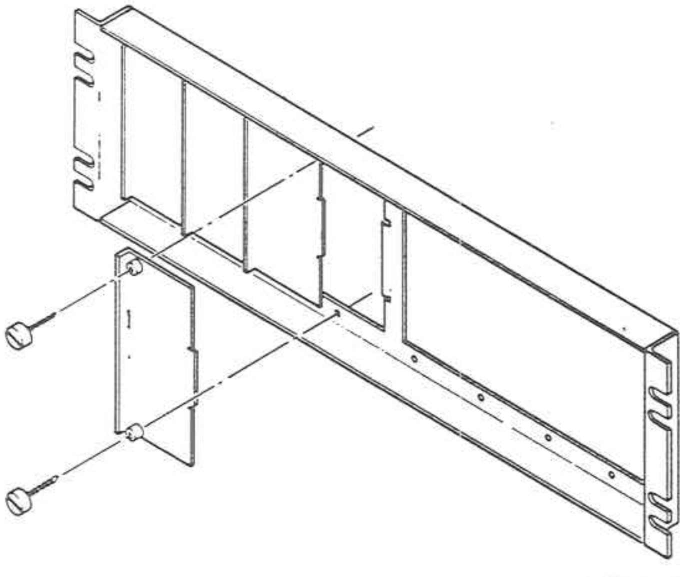


Figure 4-6. Rack-Mount Panel in CPU Cabinet

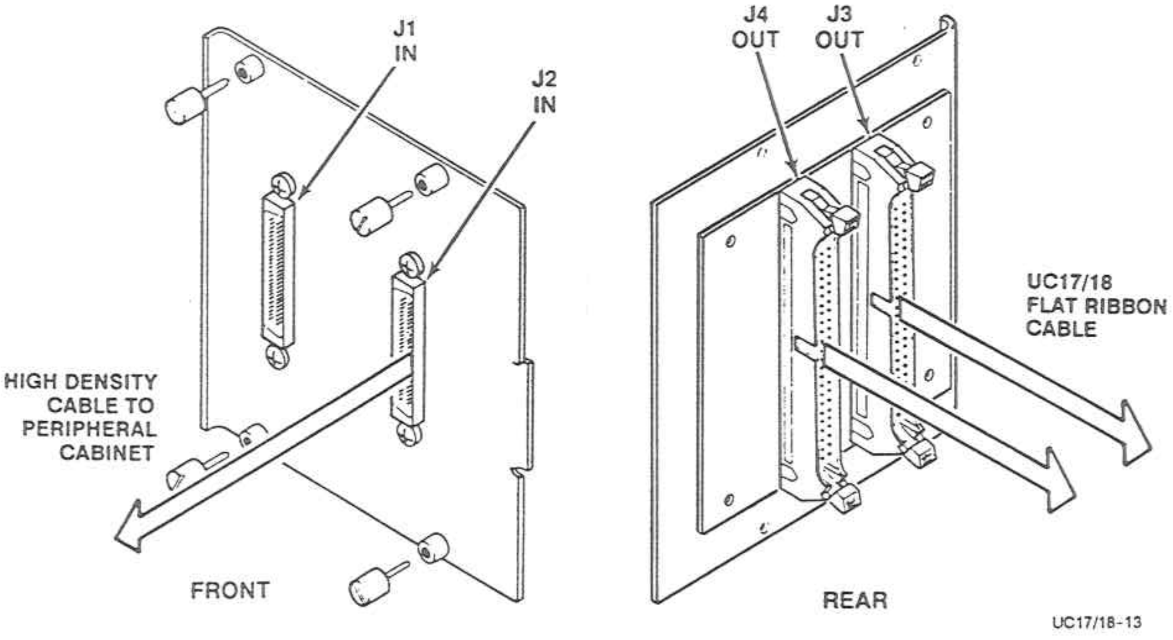


Figure 4-7. UC17/18 Distribution Panel (Peripheral Cabinet)

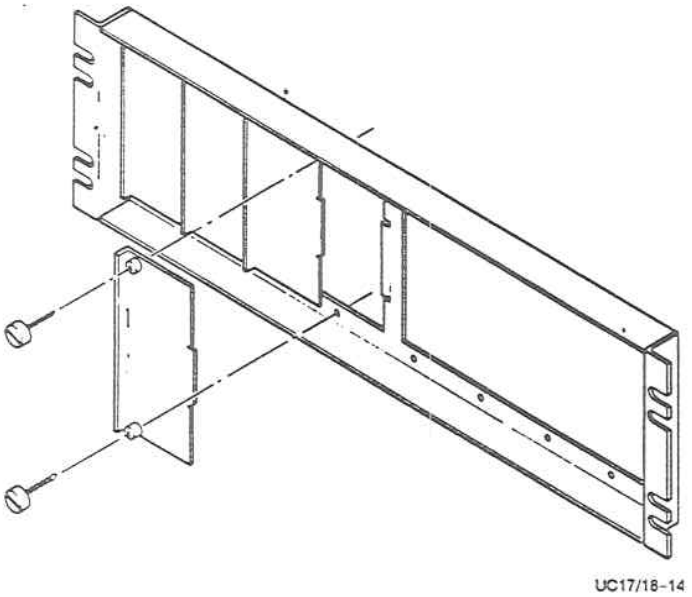


Figure 4-8. Rack-Mount Panel Cabinet in Peripheral

3. Install one rack-mount panel in the CPU cabinet. Install the other rack-mount panel containing the UC17/18 Distribution Panel in the RETMA rack in the drive cabinet (Figure 4-8).

4. Connect the round-shielded cables from the CPU distribution panel to the distribution panel in the peripheral cabinet. Align the top of the cable header on the first round-shielded cable (the cable runs out the bottom) with the top of the high-density connector J1 on the CPU distribution panel. Hold in the latch on the top of the cable header and press the header into J1; connect the other end of the cable to connector J1 IN on the peripheral distribution panel. Repeat for the second round-shielded cable from J2 on the CPU distribution panel to connector J2 IN on the peripheral distribution panel. (Cabling instructions are the same when connecting from a CPU cabinet to the peripheral, and vice versa.)

5. Connect the flat-ribbon cables from the peripheral distribution panel to the SCSI controller in the disk or tape subsystem. Align the molded arrow on the cable header of the first flat-ribbon cable with pin 1 of connector J3 OUT on the back side of the distribution panel. Press the header into J3 OUT; attach the header at the other end of the cable to the appropriate connector SCSI controller. Repeat for the second flat-ribbon cable from J4 OUT on the UC17/18 distribution panel to the appropriate connector on the second SCSI subsystem. Make sure that the latches on the connector fully engage the cable header.

6. Connect a 50-pin flat-ribbon cable from J1 on the UC17 to J3 OUT on the CPU distribution panel. For the second SCSI port (J2) on a UC18, connect another flat-ribbon cable from J2 on the UC18 to J4 OUT on the CPU distribution panel.

   Note that the maximum cumulative cable length is six meters.

   End of Procedure

4.5.6 Cabling (Same Cabinet)

If the UC17/18 and the peripherals are in the same cabinet, the UC17/18 is connected to SCSI controllers using a standard 50-wire flat cable with 50-pin headers. Connector J1 on the UC17/18 is SCSI Port 1 and J2 is SCSI Port 2. Connect these ports to the SCSI disk or tape subsystem that you intend to support with the UC17/18, observing proper cable orientation (pin 1 on J1 and J2 is marked with a triangle molded into the connector). The maximum cable length allowed is 6 meters.

4.5.6.1 Termination

SCSI buses are terminated at each end. The UC17/18 provides termination for one end of the cable. The last SCSI device on the bus must likewise terminate the bus; however, controllers daisy chained between the UC17/18 and last controller on the bus must have their terminators removed. See Appendix D for further details concerning termination and termination power.

4.5.6.2 Termination Power

The UC17/18 was designed to comply with the latest SCSI specification concerning SCSI termination power. As configured from the factory, the SCSI terminating network on the UC17/18 uses +5V supplied on pin 26 of the SCSI bus. The 5 volts can be supplied by other target devices on the SCSI bus, by the UC17/18, or a combination of both. In the factory configuration, the UC17/18 supplies power to pin 26 of the SCSI bus.

Table 4-6. Termination Power Options

Setting	Port 1 Jumper	Port 2 Jumper	Description
Fact.*	A-B IN C-D IN D-E OUT	R-P IN S-T IN T-U OUT	The UC17/18 supplies termination power to the bus. The UC17/18 termination network is connected to pin 26.

* See Appendix D for alternate termination power options.

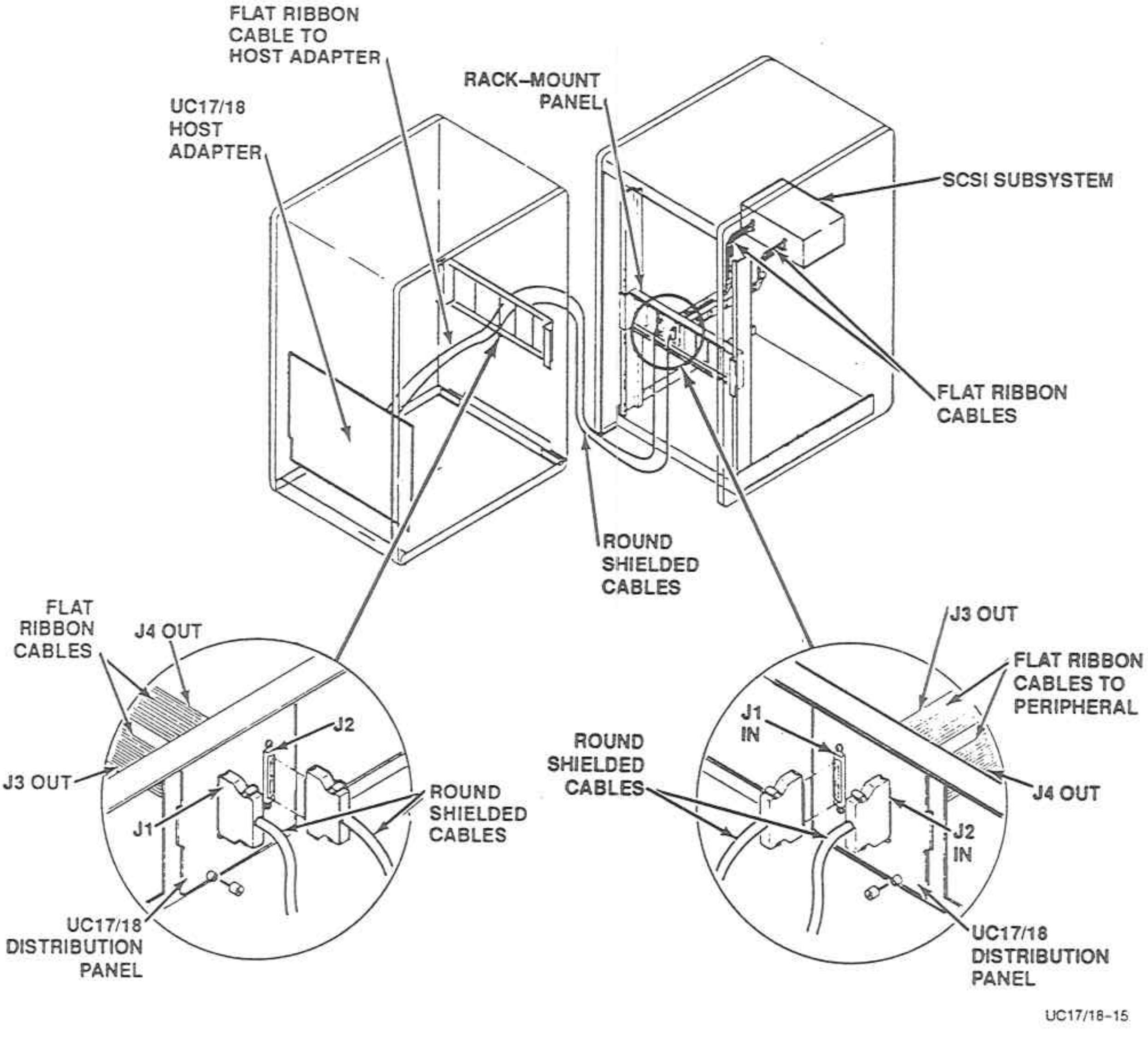


Figure 4-9. UC17/18 Subsystem Cabling

4.5.7 Starting F.R.D. on a VAX

F.R.D. is started by issuing a special command sequence via console ODT. The sequence to use is illustrated in the following example; specific commands are contained in the tables noted in parentheses. The example pertains to a VAX 750 with UNIBUS Adapter (UBA) #0 and a UC17/18 base address of 772150 (octal) or 3F468 (hex).

1. Initialize the VAX by applying power to the system and entering the console I/O mode. To initialize the UNIBUS:

```
>>>D/I 37 1<CR>                                   (Table 4-7)
```

2. Enable the map registers for two pages (must be longword aligned):

```
>>>D/L/P F30800 80000000<CR>                      (Table 4-8)
>>>D/L/P F30804 80000001<CR>
```

3. Deposit the UC17/18 "backdoor enable" code in the SA register:

```
>>>D/W/P FFF46A 3003<CR>
```

The SA register is arrived at by the following:

UBA Base Address + UC17/18 SA Register
FC0000 + 3F46A = FFF46A
(FC0000 located in Table 4-9.)
(3F46A located in Tables 4-11, 4-12)

4. Wait for 100 to appear in the SA Register:

```
>>>E/W/P FFF46A 100
```

5. Deposit the CPU identifier code in the SA register:

```
>>>D/W/P FFF46A 44xx<CR>                          (Table 4-10)
```

The value of xx is 01 for the VAX 750 UBA #0.

6. Wait for 400 to appear in the SA Register:

```
>>>E/W/P FFF46A<CR> 400
```

A value other than 400 may indicate one of the following vendor-unique errors:

SA Register (Hex)	Type of Error
8049	Timeout
8051	Driver upload failure

7. Start the F.R.D.

```
S  80<CR>
```

Table 4-7. VAX Initialization Command Sequences

VAX Model	**Initialization Command(s)**
VAX 730	`I<CR>`
VAX 750[1]	`D/I 37 1<CR>`
VAX 780,[1] 8600/8650[1]	`UNJAM<CR>`
VAX 8200[1]	20000000+720 20000[2]<CR>

[1] Console mode I/O command " I " initializes only the CPU, not the UNIBUS, for some VAX systems.

[2] The format of this sequence is Node Space Address + DWUBA Control and Status Register, followed by the Data in the UPI bit. See Table 4-8.

Table 4-8. VAX and UBA Memory Map Register Addresses

VAX Model	Address	Data	Bit Definition
730	F26800 F26804	80000000 80000001	Validity bit, PFN = 0 Validity bit, PFN = 1
750	F30800 F30804 F32800 F32804	80000000 80000001 80000000 80000001	Validity bit, DDP, PFN = 0 at UBA #0 Validity bit, DDP, PFN = 1 at UBA #0 Validity bit, DDP, PFN = 0 at UBA #1 Validity bit, DDP, PFN = 1 at UBA #1
780 and 8600/8650 on SBIA #0	20006800 20006804 20008800 20008804 2000A800 2000A804 2000C800 2000C804	80000000 80000001 80000000 80000001 80000000 80000001 80000000 80000001	Validity bit, DDP, PFN = 0 at TR #3, UBA #0 Validity bit, DDP, PFN = 1 at TR #3, UBA #0 Validity bit, DDP, PFN = 0 at TR #4, UBA #1 Validity bit, DDP, PFN = 1 at TR #4, UBA #1 Validity bit, DDP, PFN = 0 at TR #5, UBA #2 Validity bit, DDP, PFN = 1 at TR #5, UBA #2 Validity bit, DDP, PFN = 0 at TR #6, UBA #3 Validity bit, DDP, PFN = 1 at TR #6, UBA #3
8600/8650 on SBIA #1	22006800 22006804 22008800 22008804 2200A800 2200A804 2200C800 2200C804	80000000 80000001 80000000 80000001 80000000 80000001 80000000 80000001	Validity bit, DDP, PFN = 0 at TR #3, UBA #0 Validity bit, DDP, PFN = 1 at TR #3, UBA #0 Validity bit, DDP, PFN = 0 at TR #4, UBA #1 Validity bit, DDP, PFN = 1 at TR #4, UBA #1 Validity bit, DDP, PFN = 0 at TR #5, UBA #2 Validity bit, DDP, PFN = 1 at TR #5, UBA #2 Validity bit, DDP, PFN = 0 at TR #6, UBA #3 Validity bit, DDP, PFN = 1 at TR #6, UBA #3

(continued on next page)

NOTE

TR levels and UBAs listed for the VAX 780/8600/8650 are standard but may vary depending on your configuration.

Table 4-8. VAX and UBA Memory Map Register Addresses (continued)

VAX Model 8200

Data to be deposited in selected Node and Map Register:

Map Addr. Offset	Data	Bit Definition
800	80000000	Validity, DDP, PFN = 0
804	80000001	Validity, DDP, PFN = 1

Node #	Bus #0	Bus #1	Bus #2	Bus #3
0	20000000	22000000	24000000	26000000
1	20002000	22002000	24002000	26002000
2	20004000	22004000	24004000	26004000
3	20006000	22006000	24006000	26006000
4	20008000	22008000	24008000	26008000
5	2000A000	2200A000	2400A000	2600A000
6	2000C000	2200C000	2400C000	2600C000
7	2000E000	2200E000	2400E000	2600E000
8	20010000	22010000	24010000	26010000
9	20012000	22012000	24012000	26012000
10	20014000	22014000	24014000	26014000
11	20016000	22016000	24016000	26016000
12	20018000	22018000	24018000	26018000
13	2001A000	2201A000	2401A000	2601A000
14	2001C000	2201C000	2401C000	2601C000
15	2001E000	2201E000	2401E000	2601E000

Table 4-9. VAX and UBA I/O Base Addresses

VAX Model 730 I/O Address
UBA Base Address
FC0000

VAX Model 750 I/O Address
UBA Base Address

FC0000	UBA	#0
F80000	UBA	#1

VAX Models 780 and 8600/8650 on SBIA #0 I/O Address
UBA Address

20100000	TR	#3	UBA	#0
20140000	TR	#4	UBA	#1
20180000	TR	#5	UBA	#2
201C0000	TR	#6	UBA	#3

VAX Models 8600/8650 I/O Address on SBIA #1
UBA Base Address

22100000	TR	#3	UBA	#0
22140000	TR	#4	UBA	#1
22180000	TR	#5	UBA	#2
221C0000	TR	#6	UBA	#3

VAX Model 8200 I/O Address Window Space Assignments
(Window space offset values are 0 through 3FFFF)

Node #	Bus #0	Bus #1	Bus #2	Bus #3
0	20400000	22400000	24400000	26400000
1	20440000	22440000	24440000	26440000
2	20480000	22480000	24480000	26480000
3	204C0000	224C0000	244C0000	264C0000
4	20500000	22500000	24500000	26500000
5	20540000	22540000	24540000	26540000
6	20580000	22580000	24580000	26580000
7	205C0000	225C0000	245C0000	265C0000
8	20600000	22600000	24600000	26600000
9	20640000	22640000	24640000	26640000
10	20680000	22680000	24680000	26680000
11	206C0000	226C0000	246C0000	266C0000
12	20700000	22700000	24700000	26700000
13	20740000	22740000	24740000	26740000
14	20780000	22780000	24780000	26780000
15	207C0000	227C0000	247C0000	267C0000

Table 4-10. Available F.R.D. Upload Codes

(44xx) xx value	VAX and UBA Number
01	730 and 750 UBA #0
02	750 UBA #1
03	780 UBA #0 and 8600/8650 UBA #0 on SBIA #0
04	780 UBA #1 and 8600/8650 UBA #1 on SBIA #0
05	780 UBA #2 and 8600/8650 UBA #2 on SBIA #0
06	780 UBA #3 and 8600/8650 UBA #3 on SBIA #0
07	8600/8650 UBA #0 on SBIA #1
08	8600/8650 UBA #1 on SBIA #1
09	8600/8650 UBA #2 on SBIA #1
0A	8600/8650 UBA #3 on SBIA #1
10	8200 Node #0 VAXBI Bus #0
11	8200 Node #1 VAXBI Bus #0
12	8200 Node #2 VAXBI Bus #0
13	8200 Node #3 VAXBI Bus #0
14	8200 Node #4 VAXBI Bus #0
15	8200 Node #5 VAXBI Bus #0
16	8200 Node #6 VAXBI Bus #0
17	8200 Node #7 VAXBI Bus #0
18	8200 Node #8 VAXBI Bus #0
19	8200 Node #9 VAXBI Bus #0
1A	8200 Node #10 VAXBI Bus #0
1B	8200 Node #11 VAXBI Bus #0
1C	8200 Node #12 VAXBI Bus #0
1D	8200 Node #13 VAXBI Bus #0
1E	8200 Node #14 VAXBI Bus #0
1F	8200 Node #15 VAXBI Bus #0

(continued on next page)

Table 4-10. Available F.R.D. Upload Codes (continued)

(44xx) xx value	VAX and UBA Number
20	8200 Node #0 VAXBI Bus #1
21	8200 Node #1 VAXBI Bus #1
22	8200 Node #2 VAXBI Bus #1
23	8200 Node #3 VAXBI Bus #1
24	8200 Node #4 VAXBI Bus #1
25	8200 Node #5 VAXBI Bus #1
26	8200 Node #6 VAXBI Bus #1
27	8200 Node #7 VAXBI Bus #1
28	8200 Node #8 VAXBI Bus #1
29	8200 Node #9 VAXBI Bus #1
2A	8200 Node #10 VAXBI Bus #1
2B	8200 Node #11 VAXBI Bus #1
2C	8200 Node #12 VAXBI Bus #1
2D	8200 Node #13 VAXBI Bus #1
2E	8200 Node #14 VAXBI Bus #1
2F	8200 Node #15 VAXBI Bus #1
30	8200 Node #0 VAXBI Bus #2
31	8200 Node #1 VAXBI Bus #2
32	8200 Node #2 VAXBI Bus #2
33	8200 Node #3 VAXBI Bus #2
34	8200 Node #4 VAXBI Bus #2
35	8200 Node #5 VAXBI Bus #2
36	8200 Node #6 VAXBI Bus #2
37	8200 Node #7 VAXBI Bus #2
38	8200 Node #8 VAXBI Bus #2
39	8200 Node #9 VAXBI Bus #2
3A	8200 Node #10 VAXBI Bus #2
3B	8200 Node #11 VAXBI Bus #2
3C	8200 Node #12 VAXBI Bus #2
3D	8200 Node #13 VAXBI Bus #2
3E	8200 Node #14 VAXBI Bus #2
3F	8200 Node #15 VAXBI Bus #2
40	8200 Node #0 VAXBI Bus #3
41	8200 Node #1 VAXBI Bus #3
42	8200 Node #2 VAXBI Bus #3
43	8200 Node #3 VAXBI Bus #3
44	8200 Node #4 VAXBI Bus #3
45	8200 Node #5 VAXBI Bus #3
46	8200 Node #6 VAXBI Bus #3
47	8200 Node #7 VAXBI Bus #3
48	8200 Node #8 VAXBI Bus #3
49	8200 Node #9 VAXBI Bus #3
4A	8200 Node #10 VAXBI Bus #3
4B	8200 Node #11 VAXBI Bus #3
4C	8200 Node #12 VAXBI Bus #3
4D	8200 Node #13 VAXBI Bus #3
4E	8200 Node #14 VAXBI Bus #3
4F	8200 Node #15 VAXBI Bus #3

Table 4-11. VAX Offsets for MSCP Emulation

UC17/18 Bus Address (Octal)	XXXXX (Hex)	YYYYY (Hex)
17772150	3F468	3F46A
17772154	3F46C	3F46E
17760334	3E0DC	3E0DE
17760340	3E0E0	3E0E2
17760344	3E0E4	3E0E6
17760350	3E0E8	3E0EA
17760354	3E0EC	3E0EE
17760360	3E0F0	3E0F2
17760364	3E0F4	3E0F6
17760370	3E0F8	3E0FA
17760374	3E0FC	3E0FE
17760400	3E100	3E102
17760404	3E104	3E106
17760410	3E108	3E10A
17760414	3E10C	3E10E
17760420	3E110	3E112

Table 4-12. VAX Offsets for TMSCP Emulation

UC17/18 Bus Address (Octal)	IP (Hex)	SA (Hex)
17774500	3F940	3F942
17760404	3E104	3E106
17760410	3E108	3E10A
17760414	3E10C	3E10E
17760444	3E124	3E126
17760450	3E128	3E12A
17760454	3E12C	3E12E
17760504	3E144	3E146
17760510	3E148	3E14A
17760514	3E14C	3E14E
17760520	3E150	3E152
17760524	3E154	3E156
17760530	3E158	3E15A
17760534	3E15C	3E15E
17760540	3E160	3E162
17760544	3E164	3E166

Table 4-13. PDP-11 Offsets for MSCP Emulation

UC17/18 Bus Address (Octal)	XXXXX (Octal)	YYYYY (Octal)
17772150	72150	72152
17772154	72154	72156
17760334	60334	60336
17760340	60340	60342
17760344	60344	60346
17760350	60350	60352
17760354	60354	60356
17760360	60360	60362
17760364	60364	60366
17760370	60370	60372
17760374	60374	60376
17760400	60400	60402
17760404	60404	60406
17760410	60410	60412
17760414	60414	60416
17760420	60420	60422

Table 4-14. PDP-11 Offsets for TMSCP Emulation

UC17/18 Bus Address (Octal)	XXXXX (Octal)	YYYYY (Octal)
17774500	74500	74502
17760404	60404	60406
17760410	60410	60412
17760414	60414	60416
17760444	60444	60446
17760450	60450	60452
17760454	60454	60456
17760504	60504	60506
17760510	60510	60512
17760514	60514	60516
17760520	60520	60522
17760524	60524	60526
17760530	60530	60532
17760534	60534	60536
17760540	60540	60542
17760544	60544	60546